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EUROPEAN THEATER COMMAND, CONTROL, AND COMMUNICATIONS (ETC³) COMPUTER MODEL USER'S GUIDE

The BDM Corporation
7915 Jones Branch Drive
McLean, Virginia 22102

10 April 1979

Topical Report for Period 1 October 1977—10 April 1979

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DRAFT report intended to provide the user of the European Theater Communications, Command, and Control (ETC3) computer model with all information required to operate the program.

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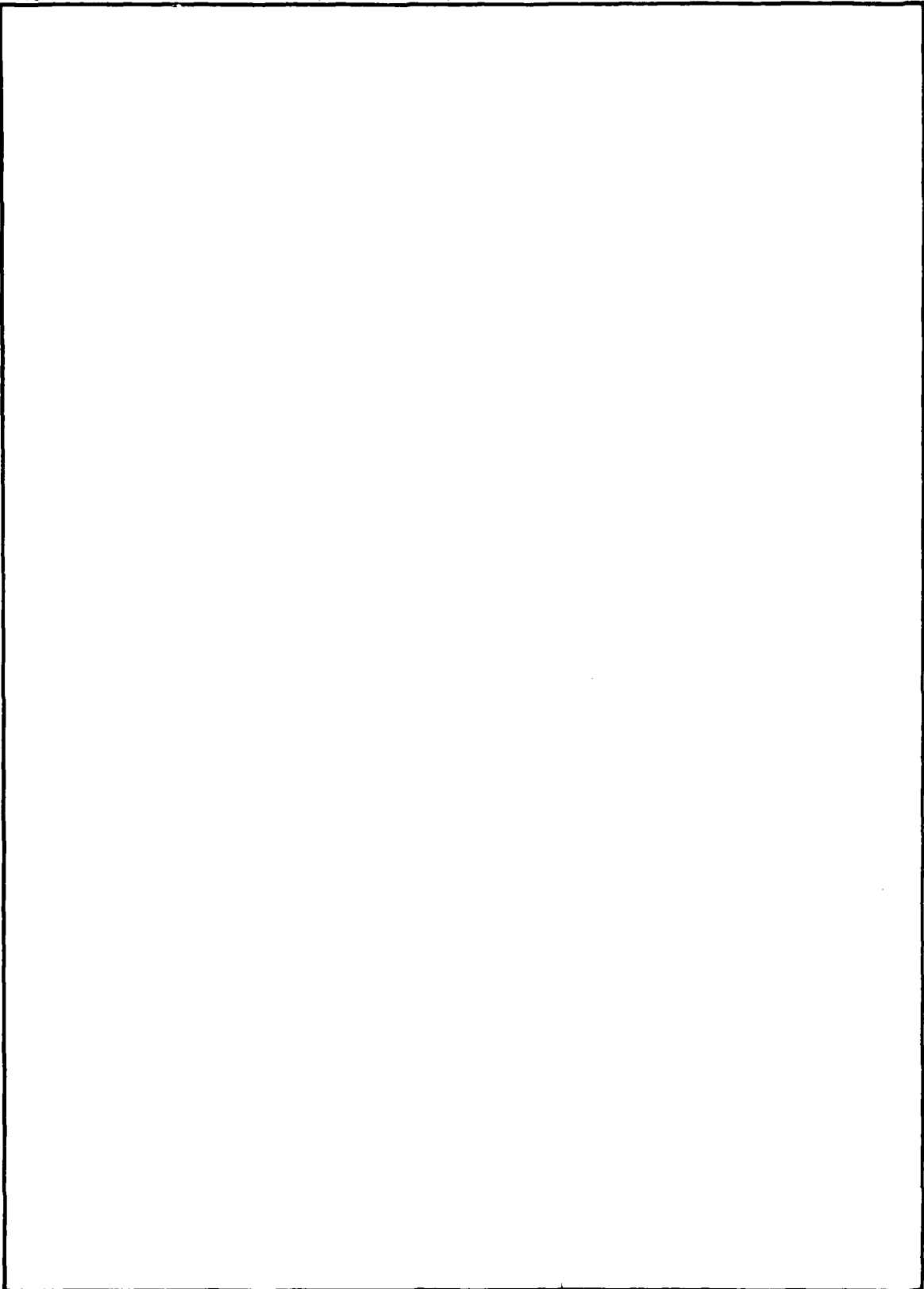
PREFACE

The BDM Corporation developed the European Theater Communication, Command, and Control (ETC^3) model for the INCA Program under Contract DNA001-77-C-0060. The ETC^3 model and associated data base may be used to study the vulnerability of communication systems to nuclear attack.

The intent of this user's guide prepared under Contract DNA001-78-00-77 is to acquaint the user of the ETC^3 model with the input data preparation and the individual program execution procedures. The ETC^3 programmer's guide which was published in November 1978 serves as a companion document that describes the model structure in sufficient detail to allow program maintenance and software modification.

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CHAPTER I
INTRODUCTION AND EXECUTIVE SUMMARY

1.0 GENERAL

In September 1974, The Defense Nuclear Agency (DNA) initiated the Integrated Nuclear Communications Assessment (INCA) Program. In support of this program, The BDM Corporation (BDM) developed computer programs and a C^3 data base to support survivability/vulnerability assessments. Reference 1 provides a detailed description of the INCA Program issues and objectives and their impact on the European Theater.

The user's manual provides the technical information needed to use the BDM European Theater Command, Control, and Communications (ETC^3) model in the support of theater C^3 vulnerability assessments. Chapter II presents the INPUT EDITOR (IE) set of computer programs which support ETC^3 and their utilization in preparing a vulnerability assessment data base. Chapter III presents the DAMAGE program which performs the nuclear weapons effect computations. This program is employed to determine the survivability of the C^3 sites and systems.

The European Theater Command, Control and Communications (ETC^3) Model Programmer' Guide (Reference 2) serves as a companion document, and it provides additional details on the program structure. These two documents provide a basis from which the ETC^3 computer code (Reference 4) can be executed and maintained.

1.1 INCA AND THE ETC^3 MODEL

INCA Program was aimed at increasing our understanding of the impact of tactical nuclear weapons effects on theater C^3. The ETC^3 model formed the basic framework for the INCA assessment methodology as well as for the generation of a data base structure to support European C^3 vulnerability assessments.

BDM support to DNA for the INCA Program resulted in two products which can be used by the Department of Defense (DoD) and other Federal activities in conducting command, control, and communications nuclear

vulnerability assessments. The first item is a data base to support European Theater C^3 vulnerability assessments. Data was evaluated and consolidated by BDM into a European Theater C^3 data base which is a comprehensive source of information on European command and control networks and communications systems. The data can be used for reference purposes and as input for the ETC^3 model.

The second product is a group of computer codes that form the ETC^3 model which can be used in nuclear vulnerability assessments of C^3 systems. Theater capabilities, especially in Europe, involve interrelated command and control networks supported by numerous communications systems. Some of these capabilities are described by the data in the ETC^3 data base. Knowledge of the probable survivability of these networks and communication systems for a variety of tactical nuclear environments is essential to integrated C^3 planning functions. However, the volume and complex interrelationships of the data used to assess nuclear vulnerability require automated rather than manual techniques to produce reasonable, acceptable assessments rapidly. The developed computer programs can aid in:

(1) preparing vulnerability assessment data bases,

(2) evaluating threat scenario effectiveness, and

(3) computing nuclear weapons effects and determining system survivability.

1.1.1 ETC^3 Data Base

The ETC^3 data base consists of data in the areas of:

(1) C^2 networks and communication systems,

(2) threat scenarios, and

(3) nuclear effects vulnerability data.

A sizable data base on NATO, European national, U.S./NATO maritime and civil communication systems which are used to support NATO C^2 has been generated. Portions of the C^3 data exist in the automated form required by the BDM computer programs. As data is collected and verified, it must be transposed into automated form to facilitate its use. The reader is referred to reference 3 for a description of the current status of the communication systems data base.

Selected threat data also forms part of the ETC^3 data base. This threat data identifies a set of NATO military installations which can be specified as targets in assessment scenarios for the purpose of assessing collateral damage to nearby C^3 systems. Included in the threat data base are the characteristics of Soviet tactical nuclear weapons, delivery systems, and an accounting of number of weapons. Two scenarios, a naval scenario developed under DNA's Naval Tactical Vulnerabilities program, and the WINTEX-75 scenario are available for use.

Vulnerability data for the C^3 systems and sites was gathered from prior analyses and may be used to specify first-order vulnerability thresholds. These first-order vulnerability thresholds can be easily modified as additional data becomes available. The values are used in the systems level assessments to assess the survivability of the C^3 structure.

1.1.2 ETC^3 Model

Nuclear damage effects to command, control, and communications systems are calculated by the ETC^3 model. The model consists of the Phase B, C, and P INPUT EDITOR (IE) programs and a nuclear weapons effect computer program (DAMAGE). The model is used to compute radiation (thermal and ionizing) and blast damage effects to communication sites, systems, and transmission capabilities from nuclear detonations. The scenario of nuclear play is developed by the user. INPUT EDITOR Phase B and C, identified as IEB and IEC, respectively, are used to generate the ETC^3 scenario or vulnerability assessment data base. Phase P of the INPUT EDITOR (IEP) is used to produce a listing of the data base in a number of formats which are suitable for analytical review. The DAMAGE program performs the damage assessment of the communications links and nodes for the indicated nuclear weapons effects. Although not part of the ETC^3 model, an optional ATTACK ALLOCATOR (AA) program was devised to permit the user to readily vary weapon lay-downs.

The model structure, shown in Figure 1.1, requires minimal user intervention once a satisfactory ETC^3 data base has been produced by the IEB and IEC programs. The data base represents the primary source of input
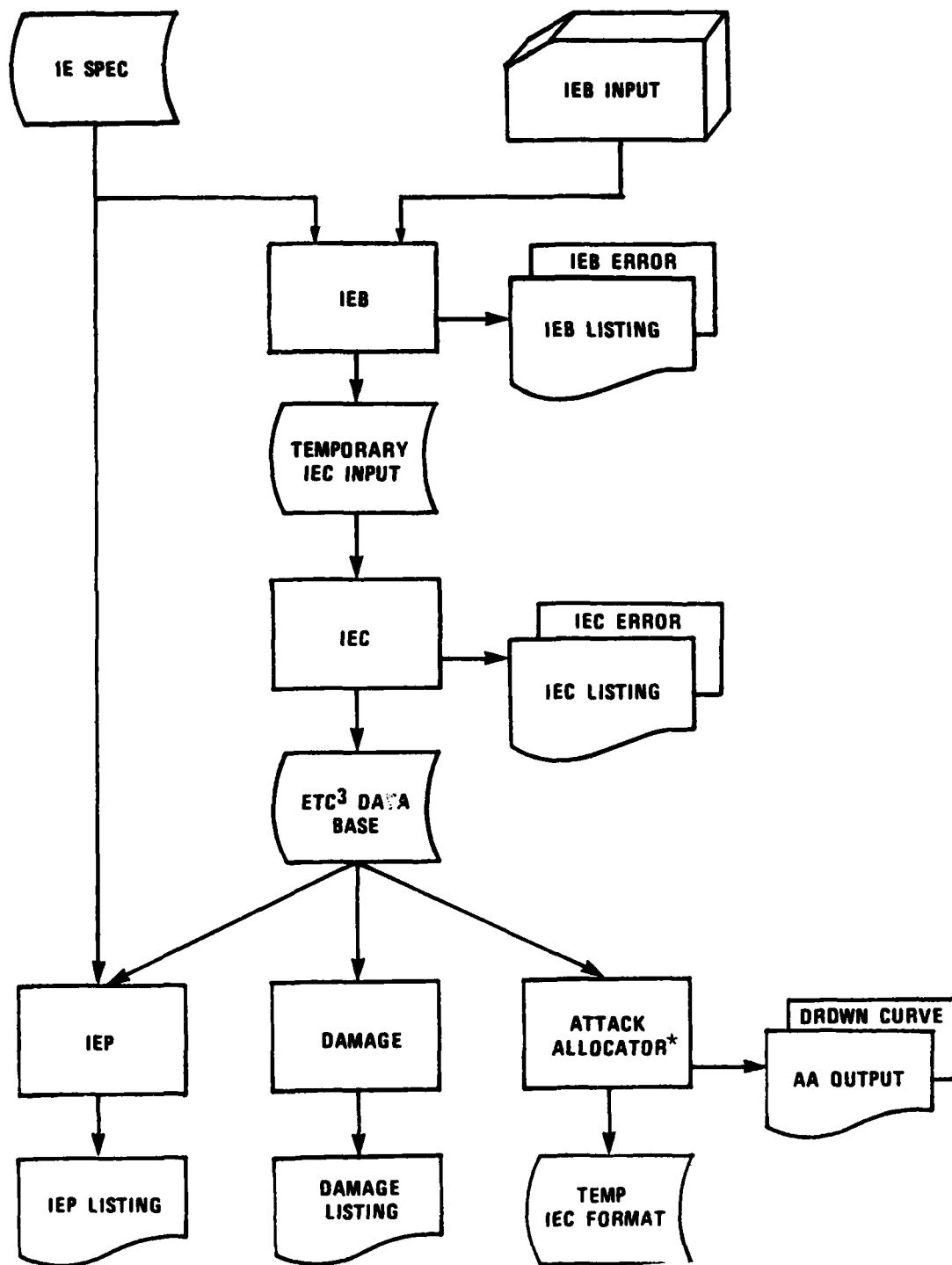
*optional, not integral part of ETC^3 model

Figure 1.1. ETC^3 model.

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data for the IEP, DAMAGE, and AA computer programs. The greatest effort required of the user is to produce the input to the IEB program and to evaluate the results from the IEC program for data consistency. The remaining programs use the IEB and IEC prepared data base as inputs for the specialized processing to produce communication system network connectivity results and nuclear damage effects. These specialized programs are applications programs which use the IE-produced data base.

Based on the preceding summary description, the major emphasis of this user's manual is on the preparation of the data base for the systems level vulnerability assessment and the description of the nuclear weapon effects which impact on the survivability of communication links, sites, and systems. More effort is required of the user in data preparation and coding than in any other process related to using the ETC^3 model. Thus a significant portion of the manual is dedicated to describing the input form of the data rather than describing how the programs are executed.

CHAPTER II
INPUT EDITOR

2.0 INTRODUCTION

The INPUT EDITOR (IE) consists of three separately executable, but interfaced, computer programs designed and developed by BDM to reduce data related problems in large scale simulations. Data related problems fall into two general categories; faulty data and inadequate data base maintenance. Faulty data problems include improper data type, values exceeding program established limits, and failure to initialize or set to default values. Data base maintenance related problems include incomplete or partial updating of the data base, poor identification or documentation, and failure to identify data element dependencies. IE performs preliminary processing of input data to reduce the occurrence of such errors.

Phase B and Phase C of the IE programs are used to consolidate all required data into a single data base with each data element occurring in a single location. The unique occurrence of each data element simplifies data update and verification procedures and can contribute to simplified design of applications programs. Default values are assigned to data elements not assigned values by the user to reduce the burden of data preparation. The assignment of default values and the use of range checks on user supplied values minimizes the occurrence of unexpected values in processing and calculations. Additionally, comments and documentation notes may be embedded in the consolidated data base to provide data base documentation and identification.

2.1 IE Structure

IE consists of the Phase B, Phase C, and Phase P computer programs and are typically used in the structure as shown in Figure 2.1. IE data base generation occurs in two phases, the first of which may occur a number of times. The initial phase is for individual sections of input data, described in 2.2, to be prepared and processed independently for correct input data syntax and permissible values, and the assignment of

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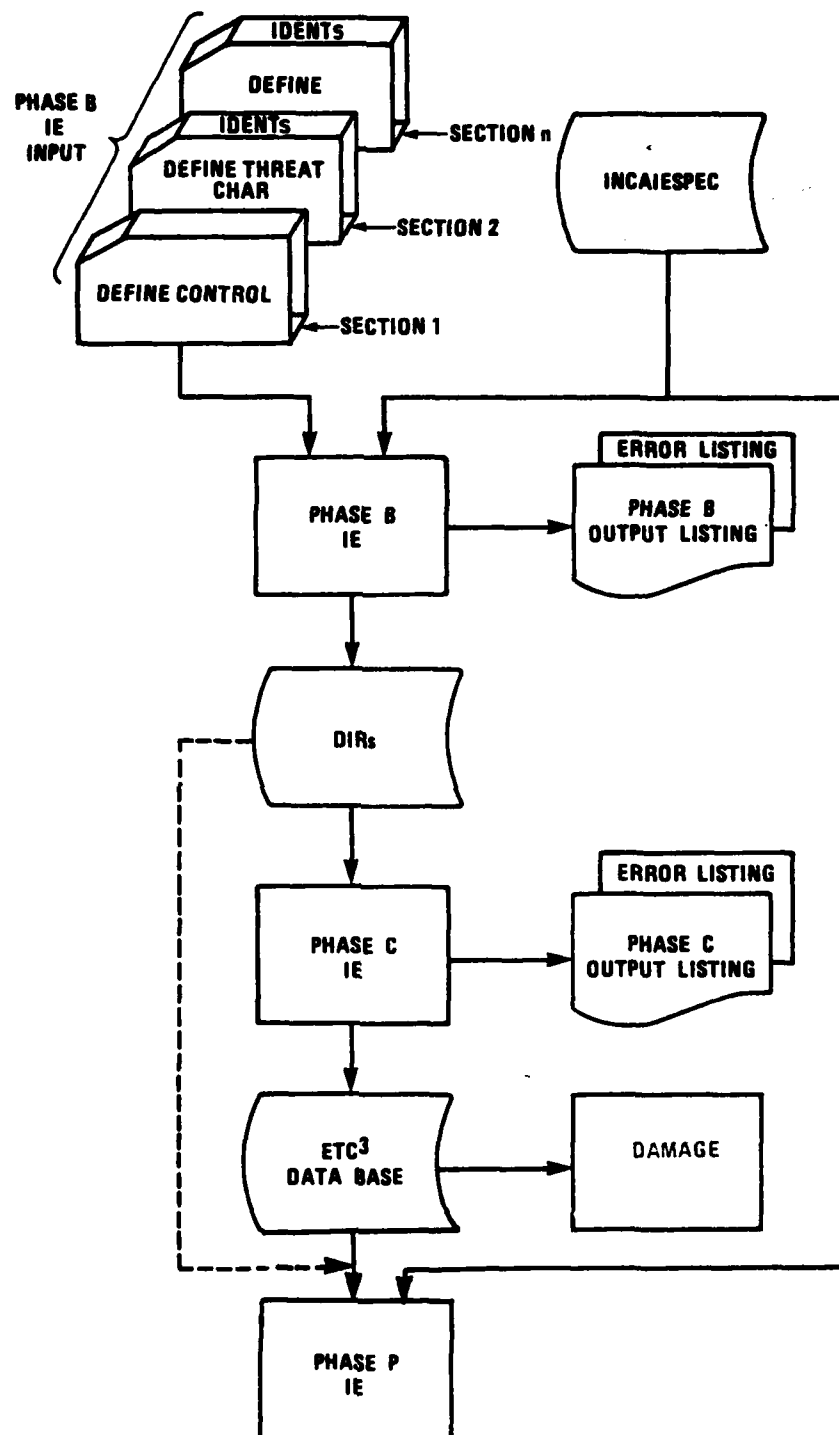
Figure 2.1.   IE structure.

default values if needed, Phase B can be executed a number of times until all input data sections are correct. It produces a set of data information records (DIRs) for use by the Phase C or Phase P programs. Usage of Phase B of IE is documented in section 2.2.

Phase C of IE does the linking and cross checking necessary of data appearing in different data input sections to establish the necessary cross references. It also does the processing needed to generate overall counts and data records required to describe the ETC^3 data base. Phase C accepts the DIRs from Phase B and produces from the DIRs the consolidated ETC^3 data base needed by the DAMAGE and ATTACK ALLOCATOR programs. Usage of Phase C of IE is documented in Section 2.3.

Phase P of IE is used to produce organized and formatted listings of the data base contents from either Phase B or Phase C program results. It produces a listing which is helpful in referencing or verifying data base contents. It can be used after Phase B execution on the resulting DIRs, but is not usually used until Phase C of IE is executed. Usage of Phase P of IE is documented in Section 2.4.

2.2 INPUT EDITOR -- Phase B (IEB)

IEB is the first of the IE programs to be used in the ETC^3 data base generation process. As previously stated, the ETC^3 data base is created in two phases, the initial phase is one in which input data sections are independently processed and the final phase is one in which the processed sections of data are linked together and all needed supporting data is generated to form a consolidated data base. The consolidated data base may be used by the Phase P IE program to produce a formatted and readable listing of the data base contents, or the DAMAGE program may use the data base for scenario nuclear effects analyses.

The ETC^3 model structure, shown in Figure 1.1, has one major interface between the user and the model. The interface is the preparation of the ETC^3 input data for the IEB program. The use of the IEC, IEP, and DAMAGE programs is a mechanical procedure consisting of setting program execution control parameter specifications and the generation of suitable

operating system job control cards to execute a particular program. The use of these programs requires minimal effort from the user.

Input data preparation for the IEB program is done by sections. Each section is processed independently, but all required sections must be successfully processed by the IEB program prior to attempting IEC program execution. Table 2.1 contains information concerning the maximum number of sections that can be processed. Figure 2.2 shows the input file structure.

User knowledge of the syntax rules and the interdependencies of the data elements within an input data section and between data sections is necessary to the successful preparation of input data for the IEB program. A section is provided below on the syntax rules for input data specification and coding, and immediately following is a description of the input data sections. A description of intra-and intersectional relationships of the input data is included. User familiarity with the syntax rules and input data sections is needed for the effective use of the ETC^3 model.

2.2.1 Syntax Rules

The syntax and formatting rules for the input data to the IEB program are designed to ease the task of creating input data for large data bases. The data base is maintained in card image form with data contained in card columns 1-72 inclusive. Data input is free field, there are no special or reserved columns for data. All input data elements are of the form:

data-name   value

where

data-name   is a name that identifies this data element, and

value   is the value for this data element.

The "data-name" identifies a data element and "value" represents the number, character string, or some other value to be assigned to the data element. The input data prepared by the user consists of specific values to be assigned the data-name. The input data can be assigned values in any of the first three categories listed below, and special characters and

Table 2.1.   Input editor section maximums.

SECTION NAME	MAXIMUM COUNT
CONTROL	1
THREATCHAR	15
SITECHAR	127
COMSYSTEMCHAR	31
MESSAGECHAR	63
PROCEDURE	127
SITE	1000
COMLINE	1000
COMNET	63
EVENT	255
THREATBM	4095
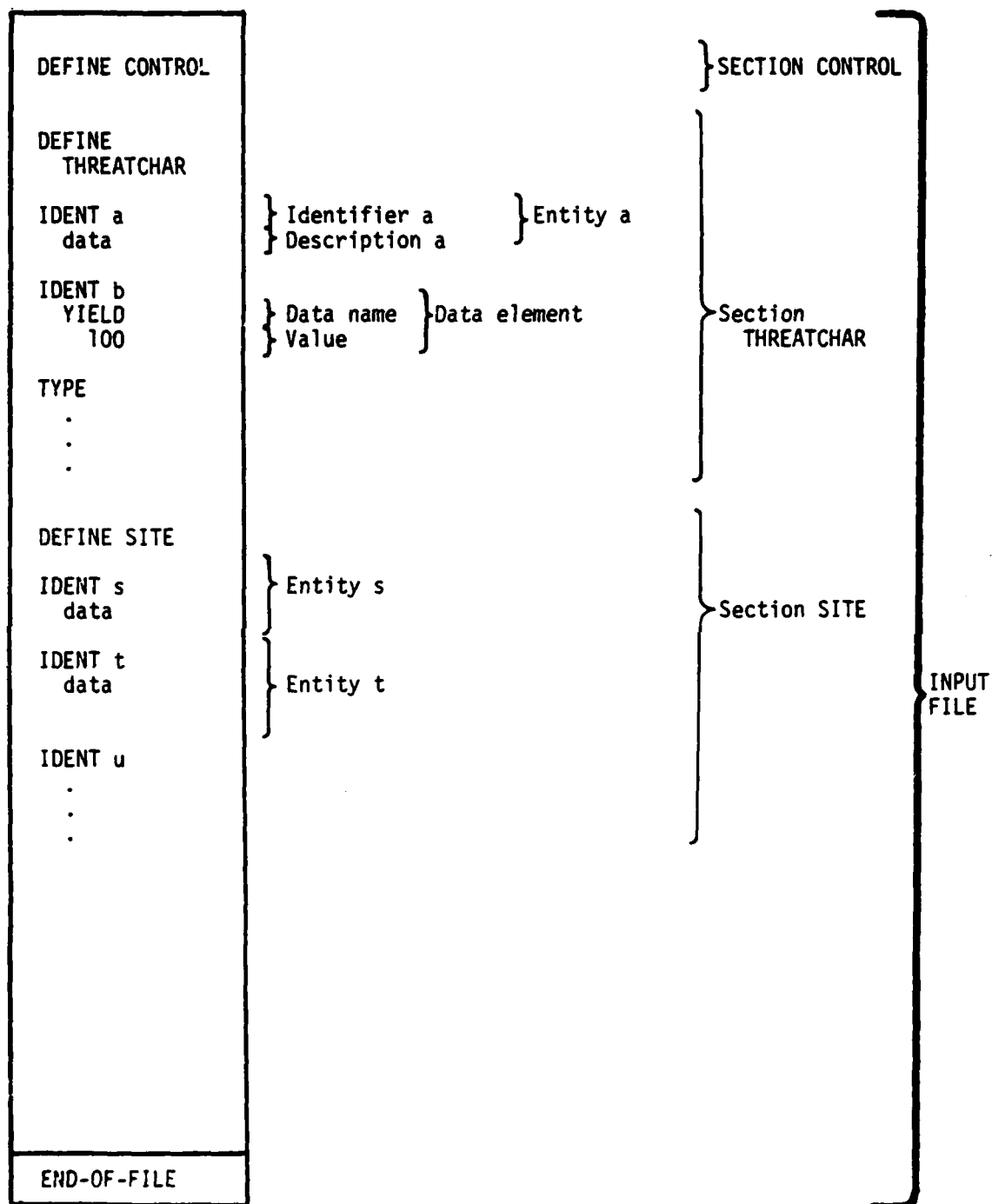
Figure 2.2.   Input data structure.

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comments may be included in the input data. Syntax rules exist under the five categorical headings:

- Names
- Numbers
- Character strings
- Comments
- Special characters

2.2.1.1 <u>Names</u>. The names are grouped into the three categories: data-names, specific-names and user-names. The syntax rules for the creation of a name are applicable to all categories of names and these rules are as follows:

- "Name" may contain 1-16 alphanumeric characters (A-Z, 0-9)
- First character must be a letter of the alphabet

a. Data-names identify data elements. The user must use the data-names or their abbreviations, spelling the names exactly as indicated in 2.2.2. Some examples of data-names are:

FREQ

IDTHREAT

CEP

b. Specific-names are names selected from a predefined list. The list contains a number of names which are suitable as input data values for a data-name. The section names are an example of specific-names. Some specific-names are:

ICBM

CONTROL

THREATCHAR

c. User-names are created by the user. They are used to identify an entity in the data base. An entity is described by all input data following the IDENT or ID data-name up to the next IDENT or DEFINE data-name. IDENT and DEFINE are documented in more detail in 2.2.2.

The user may create any user-name except the word DEFINE. Some examples of user-names are:

F106

BOMBER16

RAMSTEIN

DCS105A

Some examples of invalid names and the cause of error are:

103X	-initial character not alphabetic
F-35	-contains a dash (-)
AW A3	-contains a blank
Tauberrettersheim	-too many characters

2.2.1.2 <u>Numbers</u>. A number is made up of a string of contiguous digits 0-9 having at most one decimal point. The user of the decimal point is optional for integers. Each number is set off from all other data by a pair of delimiters, one occurring before the number, the other occurring after the number. Blanks are delimiters. A plus (+) or a minus (-) may be placed immediatey preceding a number to indicate its sign, however, the use of the plus (+) is optional. The last number in the set of following examples can be specified without the use of the decimal point.

110	-one number, one hundred ten
1 10	-two numbers, one and ten
11 0	-two numbers, eleven and zero
+3	
-7.12	
-.5	
8.	

For large or small numbers, an exponent form may be used. The digits are followed by the letter E, followed by the exponent value. Negative exponents must be preceded by a minus sign.

1.5E3	is	1500
1.3E+4	is	13000

6.7E-2	is	0.067
.5E-3	is	0.0005
2.E6	is	2000000

The E format requires more processing time than the regular format, therefore, it should be used only for very large or very small numbers. The E and subsequent exponents forms a single number, therefore blanks are not allowed before or after the E or exponent. The exponent part may not contain a decimal point.

2.2.1.3 <u>Character Strings</u>. Character strings may contain any Binary-Coded-Decimal (BCD) character. The rules for character strings are:

- Precede and follow the desired characters by an apostrophe.
- Each string can consist of 0 to 255 characters.
- If an apostrophe is to be used inside the string, two apostrophes together are used. The extra apostrophe is removed by the Input Editor.
- Comments cannot be in a character string, because the comments are treated as part of the character string.
- The ending apostrophe must be followed by a blank or other delimiter. Examples are:

'A-7'

'12*1   34$78'

'DON''T'

In the last example, the program will use DON'T as the resultant string.

To avoid problems with some communication lines when a remote terminal is used, the characters should be limited to valid printable characters. Two adjacent colons should not be used.

2.2.1.4 <u>Comments</u>. Comments may be inserted in the input wherever blanks appears. Thus, notes and documentation can be placed with the data and the program will print the comments. Each comment, no matter how long, is replaced by a single blank character. The text of a comment is never

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passed to any other program. A comment may extend over several input card images. Comments follow these rules:

- Begin the comment with /* without blank between the / and *.
- End the comment with */ without a blank between the * and /.
- Any text with any number of BCD characters is allowed.
- A comment may be placed anywhere a blank may appear except in a character string or within another comment. In a character string, the /* and */ are not recognized as comments, but as part of the character string.

Some examples of comments are:

/* AREA #1 */

/* This is the Communication System for Division 3*/

/* THIS REPORT STUDIES ONLY THE ALPHA SCENARIO*/

2.2.1.5 <u>Special Characters</u>. Several special characters are used by the Input Editor. These characters and their usage are described below.

Number	Character	Name	Use
1	+	plus	Sign of numeric data
2	-	minus	Sign of numeric data
3	.	period	Decimal point in a number
4	/*		Begin a comment
5	*/		Terminate a comment
6	'	apostrophe	Character string delimiter
7	,	comma	Separate items in a list
8	( )	parenthesis	Group items in a list
9	=	equal	Introduce a list of items
10		blank	Separator

The first six characters have already been described in the preceding paragraphs.

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a. Blank

Blanks may be used freely throughout the Input Editor input. They may or may not surround the delimiters (comma, parentheses, plus and minus signs). In general, any number of blanks may appear wherever one blank is allowed. The blank is a delimiter. It is used to separate data-names from values. The blank may also be used to separate items in a list.

b. Equal

The equal symbol is required before the left parenthesis. An optional use of the equal symbol is between a data-name and the associated value. This particular form may be found in some older data. Because this use of the equal symbol will be illegal in a future version of the Input Editor, all new data being prepared should avoid the use of the equal except where required.

c. Parentheses

Parentheses are optional in most cases, but if parentheses are used to enclose a list, there must be an equal sign between the data-name are the left parenthesis. Blanks may appear before or after the equal sign. All input lists are of the form:

data-name = (value)

"Data-name" is a data-name as described in 2.2.1.1. "Value" can have several forms:

(1) List of Numbers

Numbers in a list may be separated by a comma, or one or more blanks. Some equivalent examples are:

COMMIT = (.5,1.,.6,7,.8)

or

COMMIT   .5 1. .6 7 .8

or

COMMIT   .5,1.,.6 7 .8

(2) List of Specific-Names

A list of specific-names must be enclosed in parentheses, and there must be an equal sign between the data-name and the left

parenthesis, a comma or one or more blanks may separate specific-names in a list. Some equivalent examples are:

                    EY = (CELL   TIME   UNIT)
                    KEY = (CELL,TIME, UNIT)

    (3)   <u>List Containing A Data-Name And Its Value(s)</u>

In this case, the list must be enclosed in parentheses and there must be an equal sign between the data-name and the left parenthesis. Blanks must appear between the value and the next data-name. Commas cannot be used in this particular type of list. A valid example is:

                    ALTHIGH = (FRONT .6 BEAM .6 STERN .2)

2.2.1.6   <u>Location</u>. A frequent input is the specification of the location of a site. With the exception of the ballistic missile launch and burst locations, all locations follow the rules given below:

- The data-name is followed by an equal sign, followed by the location enclosed in parentheses.

- The UTM location follows the left parenthesis, and is composed of two letters (the 100KM square designator), followed by the Easting and Northing. The number of digits is always even and can be from 2 through 10 digits. Examples of valid UTM locations are:

AA00

NA4378

PB1234512345

- The UTM location is always within the grid zone given in the section CONTROL.

An altitude may follow UTM location. Geographic coordinates may also be used in the specification of a location. The latitude and longitude are given, respectively, in the form (dd mm ss, dd mm ss). The pairs of letters dd, mm, ss are used to designate degrees, minutes, and seconds, respectively. If the altitude is omitted, an altitude of zero meters above MSL is assumed by the program. A space separates the location and altitude value. An altitude descriptor may follow the altitude value. The designator is either "MSL" or "HAT". If neither is given, the MSL (mean sea level) is assumed.

Some examples of location inputs are:

LOC = (30 10 6, 5 10 15)

LOC = (27 30 , 5.7,200) /*THE ALTITUDE IS ASSUMED MSL*/

LOC FM980 /*ERROR , NO PARENTHESES, ODD NUMBER OF DIGITS*/

2.2.2 IEB Input Preparation

Input data to IEB can consist of up to eleven data sections, these sections are listed in Table 2.2. The input data is ordered by the same section sequence as that shown in the table. However, sections may be omitted if they are not needed for the ETC^3 data base. The CONTROL section is the single input data section which is required. It identifies the particular execution of IEB.

All other input data sections provide input data values so that the ETC^3 data base can be generated. Each section is identified by a section heading which follows the data-name DEFINE. DEFINE is the single reserved word of IEB, it cannot be used in any way other than to identify the beginning of an input data section. It acts as a section delimiter. In all sections but the CONTROL section, the data-name IDENT or its abbreviation ID is used to identify data entities for the section. A data entity consists of the group of data-names and their user assigned or IEB assigned default value. The data-names which jointly identify a data entity are described in detail on a sectional basis.

In summary, input data to IEB consists of a subset of the sections identified in Table 2.2. Each section, except the CONTROL section, is made up of data entities as required are included in each section. Each entity is fully described by a combination of user supplied and default values for the group of data-names identifying the entity.

2.2.3 Input Data

The IE produced data base is usable by a number of applications programs which access subsets of the ETC^3 data base. The DAMAGE program is an example of an applications program. In order to be usable by various applications programs, the data base contains more data than is required by

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Table 2.2.   Input data sections.

SECTION	DESCRIPTION
CONTROL	Identifies IEB execution, security classification, and UTM grid zone
THREATCHAR	Identifies a variety of threat characteristics
SITECHAR	Identifies a variety of site characteristics
COMSYSTEMCHAR	Identifies a variety of comsystem characteristics
MESSAGECHAR	Identifies a variety of message characteristics
PROCEDURE	Identifies procedures for the processing of messages
SITE	Identifies the sites by location, elevation, etc.
COMLINE	Identifies the lines connecting to comsystems or sites
COMNET	Identifies communication networks
EVENT	Identifies the events
THREATBM	Identifies ballistic missile threats

a single problem and thus results in complicating the tasks of input data collection and preparation. Consequently, input data preparation is partitioned into the input sections identified in Table 2.2.

The input data preparation process is made more precise and less subject to errors introduced by input data improperly specified by the performance of the following functions.

1. Checking the form (numeric, string, etc.)
2. Checking the limits input
3. Rounding to quantum data values
4. Converting to internal standard units
5. Checking spelling errors
6. Checking specific names against internal lists
7. Inserting default values in the DIRs
8. Inserting input values into the DIRs

In order to perform the above functions, the input data needs to be specified in a number of ways. Table 2.3 summarizes the input data as they would appear in a complete IEB input deck. The same information is presented in alphabetical order for easy access by data-name in Table 2.4. Data presentation is repetitious, but the different organizations will permit quick reference by the ETC^3 model user. User review of the input data is essential to efficient utilization of the INPUT EDITOR programs. Each data-name defined and its usage is described in these two tables.

Three types of data are accepted by the IEB program and for each data-name the column titled DATA TYPE identifies the type of data. The specific- and user-names follow the syntax rules described in 2.2.1, and in the case of specific-names, the permitted values are listed in the PHYSICAL UNITS column of each table.

Default values are assigned by the IEB program when no user values are specified. In cases where the data type is a user-name, a value is required to be provided by the user. The entry USER INPUT will occur in the DEFAULT column. For numeric data type, the value appearing in this column will be assigned the data element. The default values assigned to

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Table 2.3. Input data summary.

INPUT SECTION	DATA NAME (DN)	DN Ab.	DATA TYPE	DEFAULT	MINIMUM	MAXIMUM	QUANTUM	PHYSICAL UNITS
CONTROL	TITLE		CHAR. STRING	BLANK	0	80	1	CHARACTER
	CLASS		CHAR. STRING	BLANK	0	28	1	CHARACTER
	TERRAIN		SPECIFIC NAME	BLANK	0	16	1	CHARACTER
THREATCHAR	IDENT	ID	USER-NAME SPECIFIC NAME	USER INPUT				CHARACTER
	TYPE			BM		16	1	BM, ICBM, SLBM
	YIELD		NUMERIC	1.0	-	26843.5455	.0001	KILOTON
	CEP		NUMERIC	.0	0	16383	1	METER
	PROBVEHICLE	PV	NUMERIC	1.0	0	1	.01	UNITLESS
SITECHAR	IDENT	ID	USER-NAME SPECIFIC NAME	USER INPUT				CHARACTER
	TYPE			COM	0	16	1	COM,RELAY, C2, C3, AIRBASE, TERM
	OPKILL	OPK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS/IN^2
	DPKILL	DPK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS/IN^2
	THERMALKILL	THK	NUMERIC	255.0	1.0	254.0	1.0	CALORIES/CM^2
	GAMMAKILL	GAK	NUMERIC	65535	1.0	65534.	1.0	RADS
	GAMMADOTKILL	GMDK	NUMERIC	0	10^5	10^{14}	-	RADS/SEC
	NEUTRONKILL	NK	NUMERIC	0	-	1x10^{35}	-	NEUTRONS/CM^2
	HAEMPKILL	HEK	NUMERIC	102.3	.1	102.2	0.1	KILOVOLTS/METER
	LAEMPKILL	LEK	NUMERIC	102.3	.1	102.2	0.1	KILOVOLTS/METER
	XRAYKILL	XRK	NUMERIC	10.23	10^{-6}	10.22	10^{-6}	CAL/CM^2
	RADIATIONKILL	RDK	NUMERIC	5110.	10.	5100.	10.	REMS
	OPIMPULSEKILL	OPIK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS-SECS/IN^2
	DPIMPULSEKILL	DPIK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS-SECS/IN^2
	VULNUMBERKILL	VNK	NUMERIC	99P0.99Q0	1x0	57x9	-	UNITLESS
	PROBDAMAGEVNK	PDVNK	NUMERIC	.90	0.01	1.00	0.01	UNITLESS
	IDMESSAGECHAR	IDMC	USER-NAME	MP9999				
COMSYSTEMCHAR	IDENT	IDP	USER-NAME	USER INPUT				CHARACTER
	TYPE	ID	SPECIFIC NAME	CABLE	0	16	1	CABLE, MICROWAVE, ELF, VLF, LF, HF, VHF, UHF, SAT
	OPKILL	OPK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS/IN^2
	DPKILL	DPK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS/IN^2
	THERMALKILL	THK	NUMERIC	255.0	1.0	254.0	1.0	CALORIES/CM^2
	GAMMAKILL	GAK	NUMERIC	65535.	1.0	65534.	1.0	RADS
	GAMMADOTKILL	GMDK	NUMERIC	0	10^5	10^{14}	-	RADS/SEC
	NEUTRONKILL	NK	NUMERIC	0	-	10^{35}	-	NEUTRONS/CM^2
	HAEMPKILL	HEK	NUMERIC	102.3	.1	102.2	0.1	KILOVOLTS/METER
	LAEMPKILL	LEK	NUMERIC	102.3	.1	102.2	0.1	KILOVOLTS/METER
	XRAYKILL	XRK	NUMERIC	10.23	10^{-6}	10.22	10^{-6}	CAL/CM^2
	OPIMPULSEKILL	OKIK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS-SEC/IN^2
	DPIMPULSEKILL	DPIK	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS-SEC/IN^2
	VULNUMBERKILL	VNK	NUMERIC	99P0.99Q0	1x0	57x9	-	UNITLESS
	PROBDAMAGEVNK	PDVNK	NUMERIC	.90	0.01	1.00	0.01	UNITLESS
	FREQUENCY	FREQ	NUMERIC	1677.7215	0	1677.215	0.01	MEGAHERTZ
	CHARRATE	CR	NUMERIC		0	1677.7215	.001	CHARACTERS/SEC.
	EQUIPMENT		SPECIFIC-NAME	1677.7215	0		.0001	LINE, MODE 1, MODE 2

Table 2.3. Input data summary (continued).

MESSAGECHAR	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	CHARACTER	CHAR	NUMERIC	100	0	16777215	~	UNITLESS
PROCEDURE	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
SITE	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	LOCATION LEVEL	LOC	USER-NAME	USER INPUT	0	255	~	UNITLESS
	TERMINAL CODE	TMC	NUMERIC SPECIFIC-NAME	1 / BLANK	0	16	~	A,D,S,E,R,B,C,T,L,M,V,P,L.
	IDSITECHAR	IDC	USER-NAME	USER INPUT	0	16	~	CHARACTERS
COMLINE	IDWEAPON	IDW	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	HEIGHT OF BURST	HOB	NUMERIC	-2 X 10^7	0	16777215	~	METERS
	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	TYPE		SPECIFIC-NAME	FULL			~	ONEWAY, HALF, FULL
	NORMOPSWRATIO	SMR	NUMERIC	20	0	31	~	DECIBELS
	PROBOPBENIGN	POB	NUMERIC	1.0	0.0	1.0	.001	UNITLESS
	CAPACITY	CAP	NUMERIC	100	0	109	~	ASSIGNED BY USER
	CONNECT		USER-NAME	USER INPUT	0	16	~	CHARACTERS
	JDCONSYSCHAR	JDCSC	USER-NAME	BLANKS	0	16	~	CHARACTERS
CONNECT	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	COMLINE	LINE	USER-NAME	USER INPUT	0	16	~	CHARACTERS
EVENT	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	TYPE		SPECIFIC-NAME	USER INPUT	0	16	~	DEBUG, NODEBUG, ENDGAME, ABORT, MSG, MESSAGE
	TIME		NUMERIC	USER INPUT	0	*MAXTIME	*ONTIME	SECONDS
	IDSITExxx	IDSxxx	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	IDCOMLINE	IDCL	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	IDCOMNET	IDCN	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	IDMESSAGECHAR	IDMC	USER-NAME	USER INPUT	0	16	~	CHARACTERS
THREATBM	IDENT	ID	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	VELOCITY	V	NUMERIC	1000	.1	6553.5	0.1	METERS/SEC
	ANGLELAUNCH	AL	NUMERIC	90	0	89.9	0.0057	DEGREES
	NUMOBJECTS	NOC	NUMERIC	1	0	7	~	UNITLESS
	IDTHREATCHAR	IDC	USER-NAME	USER INPUT	0	16	~	CHARACTERS
	IDLAUNCH	IDLNCH	USER-NAME	BLANKS	0	16	~	CHARACTERS
	IDTARGET	IDTGT	USER-NAME	BLANKS	0	16	~	CHARACTERS
	TIMELAUNCH	TI	NUMERIC	0	0	268435.46	0.01	SECONDS
	TIMEBURST	T2	NUMERIC	70	0	268435.46	0.01	SECONDS
	LATBURST	F2	NUMERIC	41.5	-89	89	0.00057	DEGREES
	LONGBURST	G2	NUMERIC	87.5	-180	180	0.00057	DEGREES
	ALBURST	H2	NUMERIC	0	0	100000	1	METERS
	LATLAUNCH	F1	NUMERIC	60	-89	89	.00057	DEGREES
	LONGLAUNCH	G1	NUMERIC	-80	-180	180	.00057	DEGREES
	ALTLAUNCH	H1	NUMERIC	0	0	32767	1	METERS

Table 2.4. Data-name summary

DATA NAME (DN)	DN AB.	INPUT SECTION	DATA TYPE	DEFAULT	MINIMUM	MAXIMUM	QUANTUM	PHYSICAL UNITS
ALTBURST	H2	THREATBM	NUMERIC	0	0	100000	1	METERS
ALTLAUNCH	H1	THREATBM	NUMERIC	0	0	32767	1	METERS
ANGLELAUNCH	AL	THREATBM	NUMERIC	90	0	89.9	0.0057	DEGREES
CAPACITY	CAP	COMLINE	NUMERIC	100	0	109	1	USER ASSIGNED
CEP		THREATBM	NUMERIC	0	0	16383	1	METERS
CHARACTER	CHAR	MESSAGECHAR	NUMERIC	100	0	16777215	1	UNITLESS
CHARRAIL	CR	COMSYSTEMCHAR	NUMERIC	1677.7215	0	1677.7215	.0001	MEGAHERTZ
CLASS		CONTROL	CHARACTER STRING	BLANK	0	28	1	CHARACTERS
COMLINE	LINE	COMNET	USER-NAME	USER INPUT	0	16	1	CHARACTERS
CONNECT	CONNCT	COMLINE	USER-NAME	USER INPUT	0	16	1	CHARACTERS
DPIMPULSEKILL	DPIK	SITECHAR COMSYSTEMCHAR	NUMERIC	6553.5	0.1	6553.4	0.1	POUND-SEC/M^2
DPKILL	DPK	SITECHAR COMSYSTEMCHAR	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS/IN^2
EQUIPMENT		COMSYSTEMCHAR	SPECIFIC NAME		0.5	16777.215	0.001	LINE, NODE 1, NODE 2,
FREQUENCY	FREQ	COMSYSTEMCHAR	NUMERIC	0	0.5	16777.215	0.001	MEGAHERTZ
GAMMADOTKILL	GMDK	SITECHAR COMSYSTEMCHAR	NUMERIC	0	10	10^{14}	-	RADS/SEC
GAMMAKILL	GMK	SITECHAR	NUMERIC	65535.	1.0	65534	1.0	RADS
HALEMPKILL	HEK	COMSYSTEMCHAR SITECHAR	NUMERIC	102.3	.1	102.2	0.1	KILOVOLTS/METER
LAEMPKILL	LEK	COMSYSTEMCHAR SITECHAR COMSYSTEMCHAR	NUMERIC	102.3	.1	102.2	0.1	KILOVOLTS/METER
HEIGHTOFBURST	HOB	SITE EVENT	NUMERIC	-2 x 10^7	0	16777215	1	METERS
IDCOMLINE	IDCL	COMLINE	USER-NAME	USER INPUT	0	16	1	CHARACTERS
IDCOMSYSCHAR	IDCSC	THREATCHAR SITECHAR COMSYSTEMCHAR MESSAGECHAR PROCEDURE SITE	USER-NAME	BLANKS	0	16	1	CHARACTERS
IDENT	ID	COMLINE COMNET EVENT THREATBM	USER-NAME	USER INPUT	0	16	1	CHARACTERS

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Table 2.4. Data-name summary (continued).

Name	Abbrev	Structure	Type	Default	Min	Max	Incr.	Units
IDLAUNCH	IDLNCH	THREATBM	USER-NAME	BLANKS	0	16	1	CHARACTERS
IDMESSAGECHAR	IDMC	EVENT	USER-NAME	USER INPUT	0	16	1	CHARACTERS
IDPROCEDURE	IDP-	SITECHAR	USER-NAME	MP9999	0	16	1	CHARACTERS
IDSITExxx	IDSxxx	EVENT	USER-NAME	USER INPUT	0	16	1	CHARACTERS
IDSITECHAR	IDC	SITE	USER-NAME	USER INPUT	0	16	1	CHARACTERS
IDTARGET	IDTGT	THREATBM	USER-NAME	BLANKS	0	16	1	CHARACTERS
IDTHREATCHAR	IDC	THREATBM.	USER-NAME	USER INPUT	0	16	1	CHARACTERS
IDWEAPON	IDW	SITE	USER-NAME	USER INPUT	0	16	1	CHARACTERS
LAEMPKILL	LEK	SITECHAR COMSYSTEMCHAR	NUMERIC	102.3	0.1	102.2	.1	KILOVOLTS/METER
LATBURST	F2	THREATBM	NUMERIC	41.5	-89.	89.	0.00057	DEGREES
LATLAUNCH	F1	THREATBM	NUMERIC	60	-89.	89.	0.00057	DEGREES
LEVEL		SITE	NUMERIC	1	0	255	1	UNITLESS
LOCATION	LOC	SITE	NUMERIC, CHAR ST.	USER INPUT				DEGREES, UTM COOR., METERS.
LONG BURST	G2	THREATBM	NUMERIC	87.5	-180.	180.	0.00157	DEGREES
LONGLAUNCH	G1	THREATBM	NUMERIC	-80.	-180.	180.	0.00057	DEGREES
NEUTRONKILL	NK	SITECHAR COMSYSTEMCHAR	NUMERIC	0	1	1035	-	NEUTRONS/CM^2
NORMOPSMRATIO	SNR	COMLINE	NUMERIC	20.	0	31.	1.	DECIBELS
NUMOBJECTS	NOB	THREATBM	NUMERIC	1	0	7	1.	UNITLESS
OPIMPULSEKILL	OPIK	SITECHAR COMSYSTEMCHAR	NUMERIC					POUNDS-SEC/IN^2
OPKILL	OPK	SITECHAR COMSYSTEMCHAR	NUMERIC	6553.5	0.1	6553.4	0.1	POUNDS/IN^2
PROBDAMAGEVMK	PDVMK	SITECHAR COMSYSCHAR	NUMERIC	.90	.0.01	1.00	0.01	UNITLESS
PROBOPBENIGN	POB	COMLINE	NUMERIC	1.00	0.0	1.0	0.1	UNITLESS
PROBVEHICLE	PV	THREATCHAR	NUMERIC	1.0	0.0	1.0	0.01	UNITLESS
RADIATIONKILL	RDK	SITECHAR	NUMERIC	5110.	10.	5100.	10.	REMS
TERMINALCODE	TMC	SITE	SPECIFIC-NAME	BLANK	0	16	1	A,D,S,E,R,B,C,T,L,M,V,P,L.
TERRAIN		CONTROL	SPECIFIC-NAME	BLANK	0	16	1	
THERMALKILL	THK	SITECHAR COMSYSTEMCHAR	NUMERIC	255.	1.0	254.0	1.0	CALORIES/CM^2
TIME		EVENT	NUMERIC	USER INPUT	0	*MAXTIME	*ONTIME	SECONDS
TIMEBURST	T2	THREATBM	NUMERIC			16		
TIMELAUNCH	T1	THREATBM	NUMERIC			16		
TITLE		CONTROL	CHARACTER STRING	BLANKS	0	80	1	CHARACTERS
TYPE		THREATCHAR	SPECIFIC-NAME	BM	0	16	1	BM, ICBM, SLBM
		SITECHAR		CDM				CDM, RELAY, C2, C3, AIRBASE, TERM
		COMSYSTEMCHAR		CABLE				CABLE, MICROWAVE, ELF, VLF, LF, HF, VHF, UHF, SAT.
		COMLINE		FULL				ONEWAY, HALF, FULL
		EVENT		USER INPUT				DEBUG, NO DEBUG, END GAME, ABORT, MESSAGE, MSG.
VELOCITY	V	THREATBM	NUMERIC	1000	.1	6553.5	0.1	METERS
VULNUMBERKILL	VMK	SITECHAR COMSYSTEMCHAR		98P0, 9900	i x 0	57 X 9		UNITLESS
XRAYKILL	XRK	SITECHAR COMSYSTEMCHAR	NUMERIC	10.23	10^{-6}	10.22	10^{-6}	CAL/CM^2
YIELD		THREATCHAR	NUMERIC	1.0	0.	26843.5455	.0001	KILOTONS

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the nuclear effects data elements in the SITECHAR and COMSYSTEMCHAR sections render the sites or systems invulnerable to each effect. Although default values are assigned by the IEB program, the usage of the data is governed by the individual applications programs.

2.2.4 Input Data Sections - Detailed Descriptions

Each of the eleven input data sections is described in the following manner. A brief narrative on the purpose and general types of input data which are in the data section is presented. The data-names or inputs requiring special attention are indicated to the user. Examples of the input data for the section follow the narrative in order to illustrate the form of the input data. Following the sample input data is a table which provies a summary description of the data elements in the input section. A detailed narrative for each data element follows the table. The detailed narrative is formatted to facilitate its use as a reference manual format, and each heading is briefly described below to identify its function.

Figure 2.3 shows the format used in the input forms section of this report. The numbers correspond to the items which follow:

Item 1 -- DATA-NAME -- the data-name for the data element. This name is assigned by the ETC^3 program designer and must be input exactly as shown. The data-name always will follow the rules for names.

Item 2 -- Abbreviation -- any abbreviation(s) which may be used in place of the data-name appear here. In Figure 2.3, two abbreviations appear: PTR and P. Either abbreviation may be used in place of the data-name (but never both). The data-name and abbreviation(s) are treated as synonyms. The data-name is usually long and descriptive and is used when narrative-like input is desired. The abbreviations are used to save writing and compress the input. Program INEDP always uses the data-name, as does this documentation.

Item 3 -- DATA TYPE -- the data type gives the input mode which is acceptable to the Input Editor for this data element. Usually, this will be numeric if numbers are to be input; a character string or user name if an identifier is to be input.

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```
┌─────────────────────────────────────────────────────────────────────┐
│                                                                       │
│  1.  DATA-NAME:  PROBTRANSMITTER     2.  ABBREVIATION:  PTR P          │
│                                                                       │
│  3.  DATA TYPE:  NUMERIC             4.  APP PROGRAMS:  ABC, XYZ       │
│                                                                       │
│  5.  UNITS:  PROBABILITY             6.  GROUP NAME:  PROBABILITY (10) │
│                                                                       │
│  7.  MINIMUM:  0                     8.  MAXIMUM:  1.0                 │
│                                                                       │
│  9.  DEFAULT:  1.0                  10.  QUANTUM:  0.001               │
│                                                                       │
│  11. DESCRIPTION:   Probability that the radio transmitter is operating│
│                     at the start of the game.  If considered operating │
│                     by a random number draw, the full power output is  │
│                     used.  If considered not-operational, the power    │
│                     output is zero.  Program XYZ will begin repairs    │
│                     at game time zero, Program ABC assumes the transmitter│
│                     is down for the entire game.                       │
│                                                                       │
│  12. EXAMPLE:  PROB      .95                                           │
│                                                                       │
└─────────────────────────────────────────────────────────────────────┘
```

Figure 2.3.   Input format example.

Item 4 -- APP. PROGRAMS -- the APP. PROGRAMS are the application programs which use this data element. If none of the application programs use a data element, then this data element may be omitted from the input. Because the Input Editor can process all possible inputs, the IE programs are never listed.

Item 5 -- UNITS -- the standard units for this input. Each numeric data element is assigned one of the unit categories given in Table 2.5, Input units. The column called "Name" is the name given and is repeated on the input form. The number column is used by the Input Editor program. The "Standard Units" column gives the input units expected. The example shows "Probability" entered in this field. Table 2.5 shows that this number is 10 and that the standard input is from 0.0 through 1.0. If this were, for example, radar cross section, the input value would be square meters.

A blank, or the word NONE, in this input form entry indictates that the input units are assumed to be always in the same, standard units. Examples of such inputs are: number of missile rounds, commit ratio, neutrons per square centimeter. These data elements are assigned group number zero.

The units for nonnumeric data are the number of characters in the name or character string.

Item 6 -- GROUP NAME -- the group name is taken from Table 2.5. The group number will usually follow in parentheses. The entry "Identifier" indicates that the value for this data element can be either a user name or a character string of 16 characters or less. A blank entry always indicates group number zero.

Item 7 -- MINIMUM -- this entry is the lower limits of input. For numeric data, this is the lowest algebraic value which the program will accept. This entry is always in standard units (see Table 2.5). The Input Editor checks the input against this limit. If the input value is below this value, an error message is issued and the lower limit value is used

Table 2.5. Input units.

NUMBER	NAME	STANDARD UNITS
1	Area	meter^2
3	Weight	kilograms
4	Fuel Rate	gallons/second
5	Angle	degrees
6	Angular Velocity	degrees/second
7	Angular Acceleration	degrees/second/second
8	Frequency	megahertz
9	Altitude (Above MSL or Local Terrain)	meters
10	Probability	0 to 1.00
11	Length	meters
12	Velocity	meters/second
13	Acceleration	meters/second/second
14	Temperature	degrees celsius
16	Pressure	pounds/inch^2
18	Range	kilometers
19	Power	kilowatts
20	Time Delay	seconds
21	Volume	meter^3
22	Radar Cross-Section	meter^2
23	Ballistic Coefficient	pounds/feet^2
24	Yield (For Warheads)	kilotons
25	Fuel Quantity	gallons
26	Azimuth	degrees
27	Power Density	watts/megahertz
28	Transmission Rate	characters/second
29	Reciprocal Time	seconds^{-1}
30	Game Time	seconds

instead of the input value. The error message is of the form:

```
ERROR     section-name   data-name value-in      IS OUT OF LIMITS
limit     WILL BE USED INSTEAD level
```
where:

    section-name   is the section being processed

    data-name   is the data-name being processed. This may be the data-name even if an abbreviation was entered instead.

    value-in   is the value entered in standard units

    limit   is the lower limit which will be ued in the output DIR

    level   is the severity of the error; usually 50 is used.

Because of quantum rounding and, perhaps, conversion from one system of units to another, this error message may appear with "limit" and "value-in" having identical values. In this case, this is not really an error but a warning that rounding has occurred. The error message can be eliminated by reducing the input value slightly.

        If the lower limit has the word "None" or is blank, the Input Editor does not check the user balue.

        Item 8 -- MAXIMUM -- This entry is the upper limit of input. The description given in Item 6 above applies, with appropriate substitution of "maximum" for "minimum". The error message is the same.

        Item 9 -- DEFAULT -- the default value used if this data-name (or abbreviation) and value are not input. In the example, Input Editor assumes a value for PROBABILITY of 1.0 if this data-name is not input for an entity. The default values are chosen by the ETC^3 program designer. The programmer's manual describes how to change the default value. The default value is chosen using the criteria:

                "If this parameter was not considered by the model, what value would be assumed?"

In the example in Figure 2.3, if operability of a radio transmitter were not modeled, a reasonable assumption would be made that all radio transmitters are working and operational when the game begins. Thus, the default value of 1.0 is used.

Because the default value can be changed in the future, default values should not be relied upon for permanent, master data bases. The default value is for a "don't care" case and should be used accordingly.

Item 10 -- QUANTUM -- the quantum is used to show how the value is rounded. Some application programs pack values in partial words. To prevent loss of accuracy in application programs, numeric values are rounded to the quantum given. If the quantum is 0.001, the transformation of various input values is:

If input value is 0.0001, the value used is 0

If input value is .0014, the value used is .001

If input value is .0015, the value used is .001

If input value is .0027, the value used is .003

If input value is .0005, the value used is 0.

In the last case, usually truncation will occur because .0005 can not be represented in a binary computer with a finite number of digits. The number .0005 is actually .000499999---, where the number of 9's is finite. A blank or zero in the quantum field indicates that no rounding is performed. A single precision word will contain the numeric value unless otherwise stated.

The quantum for nonnumeric values is always one character if the units are user-name or character string. The limits concerning the maximum and minimum number of characters must be observed. A user name is always limited to 16 characters regardless of what is specified in the upper limit.

Item 11 -- DESCRIPTION -- a description of the input follows: This paragraph will explain how the data element is used by various programs and any special relationships between this input and other inputs.

Item 12 -- EXAMPLE -- An example usually follows. For complex inputs, several examples may be given.

2.2.4.1 <u>CONTROL Section</u>. The CONTROL section occurs first in the input data deck for the IEB program. It is required for the purpose of adequately identifiying the ETC^3 data base. The data base needs to be accurately labeled with respect to contents, security classification, and to insure proper geodetic to UTM coordinate conversions. The section is introduced by the data element:

DEFINE CONTROL

where DEFINE is a reserved data-name. DEFINE is used to mark the beginning of an input data section and CONTROL is a specific-name which is used to identify the first input data section. The specific-names of the input data sections have been listed in Table 2.2.

The data elements in the CONTROL section are identified in Table 2.6. The security classification (the data value for the CLASS data-name) is printed at the top and bottom margins of the output listings. The security classification, title, and the input value for the TERRAIN data-name are retained in the ETC^3 data base for documentation purposes and for coordinate conversion calculations, respectively.

Input data for the CONTROL section resemble the following example. Explanations for the data-names and values are included as comments which are acceptable to the IE and applications programs for documentation purposes, but not for processing purposes.

```
DEFINE    CONTROL                   /*SPECIFIC NAME*/
 TITLE    'EUROPEAN THEATER C3'     /*CHARACTER STRING*/
 CLASS    'TOP SECRET'
TERRAIN   '32U'                     /*CHARACTER STRING*/
```

The data values for TITLE and CLASS are in the form of character strings because of the embedded blanks, while the value for TERRAIN is treated as a character string because the first character is not a letter of the alphabet. The sequence of providing the three data elements TITLE, CLASS, and TERRAIN will not affect processing of the input data. However, the DEFINE data-name must appear first.

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Table 2.6. Control section data-names.

Data Name	Data-Name Description
CLASS	Security classification of the input data
TERRAIN	UTM grid designation for terrain related data
TITLE	Identification of the IE produced data base

1. DATA-NAME: CLASS   ABBREVIATION:

    DATA TYPE: Character string or   APP. PROGRAMS: AA, DAMAGE
                 User-name

    UNITS: GROUP NAME:

    MINIMUM: MAXIMUM:

    DEFAULT: Blanks   QUANTUM:

    DESCRIPTION: A character string of up to 28 characters or a user-
                   name is used to indicate the security classification of
                   the input data. The security classification is printed
                   at the top and bottom of the listing pages by IE and
                   application programs.

    EXAMPLE: CLASS 'SECRET'
               CLASS 'TOP SECRET'   /*A CHARACTER STRING MUST BE USED
                                        BECAUSE OF THE EMBEDDED BLANK*/

2. DATA-NAME: TERRAIN   ABBREVIATION:

    DATA TYPE: Character string   APP. PROGRAMS: AA, DAMAGE

    UNITS: GROUP NAME:

    MINIMUM: MAXIMUM:

    DEFAULT: Blanks   QUANTUM:

    DESCRIPTION: Input values may be one of the following grid zones;
                   32U, 00A, 51S, 52S, 19T, or 33U. The grid zone is
                   needed for the UTM to geodetic coordinate conversion
                   computations. Geodetic coordinates outside the UTM
                   grid zone may result in conversion errors. If all
                   coordinates are in latitude and longitude, this data
                   element may be omitted.

    EXAMPLE: TERRAIN '32U'

3. DATA-NAME: TITLE   ABBREVIATION:

    DATA TYPE: Character string or   APP. PROGRAMS: AA, DAMAGE
                User-name

    UNITS: GROUP NAME:

    MINIMUM: ,   MAXIMUM:

    DEFAULT: Blanks   QUANTUM:

    DESCRIPTION: A character string of up to 80 characters or a user-
                   name is used to identify the execution of the IE. It
                   is printed by IE and application program listings for
                   documentation purposes.

    EXAMPLE: TITLE   'ETC^3 DATA BASE FOR GUNDNETZ'
               TITLE   GRUNDNETZ

2.2.4.2 THREATCHAR Section. The THREATCHAR section is used to define sets of threat characteristics to be included in the ETC^3 data base. This section of data is optional and may be omitted if an attack scenario is not used. If used, the section is introduced by the following entry:

DEFINE THREATCHAR

where THREATCHAR is a specific-name used to designate this section of data. Sections appear in the input deck if required, otherwise, they should be omitted. THREATCHAR section occurs second in a complete input data deck.

The data elements, which are used to define a set of threat characteristics, are presented in Table 2.7. Each set of threat character- istics is introduced by the data-name, IDENT, and identified by a user-name or a character string. The IDENT entry is followed by a subset of the remaining data-names and their input values. These appear once per set of threat characteristics and may be in any sequence. This is possible because the data-name identifies the input data which follows. If any or all data-names are omitted from the input, default values, if they exist, are assigned to the omitted data elements.

TABLE 2.7. THREATCHAR SECTION DATA-NAMES.

Data Name	Data-Name Description
IDENT	Name or character string identifying the threat
CEP	Circular error probable of the type of threat
PROBVEHICLE	Operational probability of the type of threat
TYPE	Missile type for the threat
YIELD	Nuclear yield of the threat

Each set of threat characteristics may be referenced by data in other input sections. This is done by referring to the name or character string assigned to the set of threat characteristics. This eliminates redundant entry of data because a number at threats may share the same characteristics. The threat characteristic sets in this section are refer- enced exactly in this manner by the data elemnt IDTHREATCHAR in the

THREATBM data section. Such data associations are summarized in Tables 2.15 and 2.16 presented near the end of this chapter.

Input data for the THREATCHAR section can resemble the following example. Explanations for the data entry will be included in the same way as was included in the CONTROL section. This method of explanation will be used throughout to demonstrate the documentation power of using comments.

```
DEFINE THREATCHAR        /* INTRODUCES THREATCHAR SECTION */
IDENT  SLBM              /* SLBM THREAT CHARACTERISTICS*/
CEP    200               PROBVEHICLE  .9   TYPE  SLBM  YIELD  100
IDENT  ICBM              /* ICBM THREAT CHARACTERISTICS*/
CEP    100                                 TYPE  ICBM  YIELD  100
IDENT  BM                /* BM THREAT WITH DEFAULT VALUES*/
```

The above example of a THREATCHAR input section consists of three sets of threat characteristics identified as SLBM, ICBM, and BM. These are the user-names to be referenced if the associated characteristics are needed to describe a particular threat. SLBM, ICBM or BM may be used when the user wishes to assign a launch time to each delivery system. In this event the model will calculate an impact time based on range and a nominal ballistic flight trajectory. If the launch platform or delivery system is not ballistic (e.g., a cruise missile) then SLBM and ICBM should not be used. However, in this situation, the model will not compute impact time based on launch time, rather the impact time, if required, must be specified in the THREATBM section of the program (see 2.2.4.11). The last set of threat characteristics, identified as BM, is assigned all default values because all data elements are omitted (except IDENT).

1. DATA-NAME: IDENT   ABBREVIATION: ID

   DATA TYPE: Character String or   APP. PROGRAMS: AA, DAMAGE
              User-name

   UNITS: GROUP NAME: Identifier

   MINIMUM: MAXIMUM:

   DEFAULT: user assigned   QUANTUM:

   DESCRIPTION: The character string or user-name identifies an entity
                   in the THREATCHAR section. The identification enables
                   data input in other sections to reference the specific
                   set of threat characteristics represented by this name.
                   The data-name IDENT must precede other data for this
                   entity, and must be specified.

   EXAMPLE: IDENT 'SS-9'
              ID   THREAT1

2. DATA-NAME: CEP   ABBREVIATION:

   DATA TYPE: Numeric   APP PROGRAMS: AA, DAMAGE

   UNITS: meters   GROUP NAME: Length (11)

   MINIMUM: 0.0   MAXIMUM: 16383.0

   DEFAULT: 0.0   QUANTUM: 1.0

   DESCRIPTION: The input value specifies the accuracy of the threat in
                   terms of the circular error probable (CEP). The CEP is
                   specified in distance. The default value results in
                   zero aim error, i.e., the designated burst point is the
                   actual burst point.

   EXAMPLE: CEP   3000

3. DATA-NAME: PROBVEHICLE   ABBREVIATION: PV

    DATA TYPE: Numeric   APP. PROGRAMS: AA

    UNITS: GROUP NAME: Probability (10)

    MINIMUM: 0.00   MAXIMUM: 1.00

    DEFAULT: 1.00   QUANTUM: 0.01

    DESCRIPTION: The input value specifies the probability that a threat
                    delivery vehicle type is operational at the start of a
                    simulation game. The default value indicates the
                    vehicle is operational.

    EXAMPLE: PV   .90

4. DATA-NAME: TYPE   ABBREVIATION:

    DATA TYPE: Specific-name   APP PROGRAMS: AA, DAMAGE

    UNITS: GROUP NAME: Name

    MINIMUM: MAXIMUM:

    DEFAULT: BM   QUANTUM:

    DESCRIPTION: The specific-name (BM, ICBM, SLBM) assigned identifies
                    the type of threat vehicle. The ETC^3 model recognizes,
                    but is not restricted to, the three types of threat
                    vehicles identified above.

    EXAMPLE: TYPE ICBM

5. DATA-NAME: YIELD   ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS: AA, DAMAGE

    UNITS: Kilotons   GROUP NAME: Yield (24)

    MINIMUM: 0   MAXIMUM: 26843.5455

    DEFAULT: 1   QUANTUM: 0.0001

    DESCRIPTION: The input value represents the nuclear yield of a
                    warhead type. Conventional warhead yields must be
                    converted to an equivalent nuclear yield by the user.
                    A zero yield is treated as a decoy warhead and does not
                    produce damage effects. The weapon yield is considered
                    in the damage assessment for a burst. A default yield
                    value of 1.0 kiloton is assigned if a value is not
                    supplied.

    EXAMPLE: YIELD   20

2.2.4.3 <u>SITECHAR Section</u>. The SITECHAR section is used to define sets of characteristics which may be generally applicable to the description of particular sites. The data elements constituting a set of site characteristics provides considerable flexibility in specifying site features at the systems level. The use of this input data section is optional; but, when used, it is introduced by:

DEFINE SITECHAR

where SITECHAR is the specific-name for this section. Data for this section, which begins with the DEFINE SITECHAR and includes all the data up to the next DEFINE data name, follows the THREATCHAR section data in a complete input data deck.

Data elements in this section are used to define two major categories of features for a site. The majority of the data elements are used to specify threshold values for damage to the site from nuclear effects. The remaining data elements are used to define communication related characteristics of the site. The data-names, which are used to define a set of characteristics, are identified in Table 2-8. As in other data sections, each set of characteristics is identified by the user-name or character string following the IDENT data-name. This identifier can be used by input data in other sections to reference a specific set of characteristics.

The IDMESSAGECHAR data-name may be used any number of times in defining a set of site characteristics, however, all other data-names should be used only once in a set of characteristics. The IDMESSAGECHAR input data is required to appear before the IDPROCEDURE data entry. The IDENT, IDMESSAGECHAR, and IDPROCEDURE are required to appear in this sequence in the input data. However, their appearance is not required to be consecutive.

Many of the data-names used to specify damage threshold levels can accept two numeric input values. The first value is the threshold level and the second value is a sigma specification for probability of damage from the nuclear effect for the threshold value. The probabilistic approach to nuclear effects damage assessment is not currently a part of the ETC^3 model, however, the provision for incorporating probabilistic data in the data base exists in the IEB program.

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Table 2.8.   SITECHAR section data-names.

DATA-NAME	DATA-NAME DESCRIPTION
IDENT	Name or character string identifying a set of site characteristics
DPIMPULSEKILL	Threshold level for dynamic pressure impulse site destruction
DPKILL	Threshold level for dynamic pressure site destruction
GAMMADOTKILL	Threshold level for gamma radiation flux site destruction
GAMMAKILL	Threshold level for gamma radiation site destruction
HAEMPKILL	Threshold level for high altitude EMP (HAEMP) site destruction
IDMESSAGECHAR	Name of character string for referencing a set of message characteristics procedure
IDPROCEDURE	Name of character string for referencing a message processing procedure
LAEMPKILL	Threshold level for low altitude EMP (LAEMP) site destruction
NEUTRONKILL	Threshold level for neutron radiation site destruction
OPIMPULSEKILL	Threshold level for overpressure impulse site destruction
OPKILL	Threshold level for overpressure site destruction
PROBDAMAGEVNK	Probability of site damage for the given vulnerability number
RADIATIONKILL	Threshold level for radiation site destruction
THERMALKILL	Threshold level for thermal radiation site destruction
TYPE	Specific-name designating the type of site
VULNUMBERKILL	Threshold vulnerability number for site destruction
XRAYKILL	Threshold level for X-ray radiation site destruction

SITECHAR section input data will resemble the sample included below. In this sample input section, many of the data elements will be omitted and the abbreviated form of the data-names used. Omitted data elements are assigned in the default values described in the data-names and result in the same processing as the use of the full data-names. The data-names must appear exactly as in their full or abbreviated forms; otherwise they will not be recognized.

```
DEFINE       SITECHAR
   IDENT      RELAY
     OPKILL     200
     DPKILL      50
     TYPE      RELAY
```

1. DATA-NAME: IDENT   ABBREVIATION: ID

    DATA TYPE: Character string or   APP. PROGRAMS:
                user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The identifier is used as a label for a set of charac-
                   teristics which describe a site. It is also referenced
                   by input data in other sections to access site char-
                   acters data. The identifier indicates the beginning of
                   an entity and should precede all other data-names.
                   This data element is required.

    EXAMPLE: IDENT   HARDCOMCENTER

2. DATA-NAME: DPIMPULSEKILL   ABBREVIATION: DPIK

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Psi seconds   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 6553.4

    DEFAULT: 6553.5   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold level which must be
                    equalled or exceeded in order to render a site ineffec-
                    tive from dynamic pressure impulse effects. The
                    default value indicates the site in invulnerable to
                    this nuclear effect.

    EXAMPLE: DPIMPULSIKILL 25.0

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0   MAXIMUM: 10

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the DPIMPULSEKILL
                    level given above. If used, this numeric value
                    directly follows the DPIMPULSIKILL hardness level.

    EXAMPLE: DPIMPULSEKILL 25.0   7.5

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3. DATA-NAME: DPKILL   ABBREVIATION: DPK

DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

UNITS: Psi   GROUP NAME:

MINIMUM: *0.1   MAXIMUM: 6553.4

DEFAULT: 6553.5   QUANTUM: 0.1

DESCRIPTION: The value represents the threshold level which must be
                attained in order to render the site ineffective due to
                dynamic overpressure. The default value of 6553.5 is
                equivalent to making the site invulnerable to this
                effect.

EXAMPLE: DPKILL .220

DATA-NAME: ABBREVIATION:

DATA TYPE: Numeric   APP PROGRAMS:

UNITS: GROUP NAME:

MINIMUM: 0.0   MAXIMUM: 10.0

DEFAULT: 0.0   QUANTUM:

DESCRIPTION: The sigma value corresponding to the DKPILL level given
                above. If used, this numeric value directly follows
                the DPKILL hardness level.

EXAMPLE: DPKILL .220   4.3

4. DATA-NAME: GAMMADOTKILL   ABBREVIATION: GMDK

    DATA TYPE: Numeric   APP. PROGRAMS: AA, DAMAGE

    UNITS: Rads/second   GROUP NAME:

    MINIMUM: 1×10^5 MAXIMUM: 1×10^{14}

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The value is the threshold level which must be equalled
                    or exceeded in order to render the site inoperative
                    from gamma ray flux effects. The default value of 0 is
                    used to signify a site invulnerable to this nuclear
                    effect.   .

    EXAMPLE: GAMMADOTKILL   1E7

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0   MAXIMUM: 10

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the GAMMADOTKILL level
                    given above. If used, this numeric value directly
                    follows the GAMMADOTKILL hardness level.

    EXAMPLE: GAMMADOTKILL   2E7   5.3

5. DATA-NAME: GAMMAKILL   ABBREVIATION: GMK

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Rads   GROUP NAME:

    MINIMUM: 1   MAXIMUM: 65534

    DEFAULT: 65535   QUANTUM: 1

    DESCRIPTION: The value indicates the threshold level which must be
                    equalled or exceeded in order to render the site inoper-
                    ative from gamma ray effects. The default value
                    signifies a site invulnerable to gamma effects.

    EXAMPLE: GAMMAKILL   9.75

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the GAMMAKILL level
                    given above. If used, this numeric value directly
                    follows the GAMMAKILL hardness level.

    EXAMPLE: GAMMAKILL   9.75   4.2

6. DATA-NAME: HAEMPKILL   ABBREVIATION: HEK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Kilovolts/meter   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 102.2

    DEFAULT: 102.3   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold value which must be
                   equalled or exceeded in order to render a site inopera-
                   tive from high altitude electromagnetic pulse effects.
                   A default value of 102.3 is used to signify a site
                   invulnerable to HAEMP effects.

    EXAMPLE: HAEMPKILL   90.2

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the HAEMPKILL level
                   given above. If used, this numeric value directly
                   follows the HAEMPKILL hardness level.

    EXAMPLE: HAEMPKILL   90.2   2.0

7.   DATA-NAME: IDMESSAGECHAR   ABBREVIATION: IDMC

     DATA TYPE: Character string or   APP. PROGRAMS:
                  user-name

     UNITS: GROUP NAME:

     MINIMUM: MAXIMUM:

     DEFAULT: QUANTUM:

     DESCRIPTION: The character string or user-name identifies the
                    message to be processed. The IDMESSAGECHAR data
                    element must precede the IDPROCEDURE data element of
                    this input section. More than one IDMESSAGECHAR entry
                    may appear for each site entity.

     EXAMPLE: IDMESSAGECHAR

8.   DATA-NAME: IDPROCEDURE   ABBREVIATION: IDP

     DATA TYPE: Character string or   APP PROGRAMS:
                  user-name

     UNITS: GROUP NAME:

     MINIMUM: MAXIMUM:

     DEFAULT: MP9999   QUANTUM:

     DESCRIPTION: The character string or user-name assigned corresponds
                    to a procedure specified in the PROCEDURE input data
                    section. This referenced procedure performs the
                    required processing on the messages identified with
                    respect to the IDMESSAGECHAR data name.

     EXAMPLE: IDPROCEDURE

9. DATA-NAME: LAEMPKILL   ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Kilovolts/meter   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 102.2

    DEFAULT: 102.3   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold level for rendering
                    a site ineffective due to low altitude EMP effects.
                    The default value signifies a site which is invulner-
                    able to low altitude EMP effects.

    EXAMPLE: LAEMP   22.4

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the LAEMPKILL level
                    given above. If used, this numeric value directly
                    follows the LAEMPKILL hardness level.

    EXAMPLE: LAEMP   22.4   1.5

10. DATA-NAME: NEUTRONKILL   ABBREVIATION: NK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Neutrons/cm^2 GROUP NAME:

    MINIMUM: 1   MAXIMUM: 1×10^{35}

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The value is the threshold for damage to a site by neutron radiation. The input value must be equalled or exceeded in order to render the site inoperative. The default value of 0 signifies an invulnerable site to neutron radiation.

    EXAMPLE: NEUTRONKILL   1E10

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the NEUTRONKILL level given above. If used, this numeric value directly follows the NEUTRONKILL hardness level.

    EXAMPLE: NEUTRONKILL   2.5E9   2.7

11. DATA-NAME: OPIMPULSEKILL   ABBREVIATION: OPIK

DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

UNITS: Psi seconds   GROUP NAME:

MINIMUM: 0.1   MAXIMUM: 6553.4

DEFAULT: 6553.5   QUANTUM: 0.1

DESCRIPTION: The value is the threshold level for overpressure impulse damage to a site. A result equal to or greater than the input value will result in a inoperative site. The default value represents a site invulnerable to this nuclear effect.

EXAMPLE: OPIMPULSEKILL   8.7

DATA-NAME: ABBREVIATION:

DATA TYPE: Numeric   APP PROGRAMS:

UNITS: GROUP NAME:

MINIMUM: 0.0   MAXIMUM: 10.0

DEFAULT: 0.0   QUANTUM:

DESCRIPTION: The sigma value corresponding to the OPIMPULSEKILL level given above. If used, this numeric value directly follows the OPIMPULSEKILL hardness level.

EXAMPLE: OPIMPULSEKILL   18.3   1.7

12. DATA-NAME: OPKILL   ABBREVIATION: OPK

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Psi   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 6553.4

    DEFAULT: 6553.5   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold overpressure level
                  which must be equalled or exceeded in order to result
                  in an inoperative site from overpressure blast effects.
                  The default value of 6553.5 signifies a site which is
                  invulnerable to overpressure damage effects.

    EXAMPLE: OPKILL   157

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0   MAXIMUM: 10

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the OPKILL level given
                  above, if used, this numeric value directly follows the
                  OPKILL hardness level.

    EXAMPLE: OPKILL   14   1.2

13. DATA-NAME: PROBDAMAGEVNK   ABBREVIATION: PDVNK

DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

UNITS: GROUP NAME: Probability

MINIMUM: 0.01   MAXIMUM: 1.00

DEFAULT: 0.90   QUANTUM: 0.01

DESCRIPTION: The value represents the probability of damage to a
               site vased on the site vulnerability number; see
               VULNUMBERKILL which follows.

EXAMPLE: PDVNK   .80

14. DATA-NAME: RADIATIONKILL   ABBREVIATION: RDK

     DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

     UNITS: Rems   GROUP NAME:

     MINIMUM: 10   MAXIMUM: 5100

     DEFAULT: 5100   QUANTUM: 10

     DESCRIPTION: The value represents the threshold value for damage to
                     a site due to radiation effects. The assigned value
                     must be equalled or exceeded in order to result in an
                     inoperative site. The default value of 5110.0 signi-
                     fies a site which is not vulnerable to radiation
                     effects.

     EXAMPLE: RADIATIONKILL   2500
               RDK   2500

     DATA-NAME: ABBREVIATION:

     DATA TYPE: Numeric   APP PROGRAMS:

     UNITS: GROUP NAME:

     MINIMUM: 0.0   MAXIMUM: 10.0

     DEFAULT: 0.0   QUANTUM:

     DESCRIPTION: The sigma value corresponding to the RADIATIONKILL
                     level given above. If used, this numeric value
                     directly follows the RADIATIONKILL Hardness level.

     EXAMPLE: RADIATIONKILL   2500   1.5
               RDK   2500   1.5

15. DATA-NAME: THERMALKILL   ABBREVIATION: THK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Cal/cm^2 GROUP NAME:

    MINIMUM: 1.0   MAXIMUM: 254.0

    DEFAULT: 255.0   QUANTUM: 1.0

    DESCRIPTION: The value indicates the threshold level which must be
                   equalled or exceeded in order to render a site inopera-
                   tive from thermal radiation effects. The default value
                   signifies a site which is invulnerable to thermal
                   radiation effects.

    EXAMPLE: THERMALKILL   127
              THK   127

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the THERMALKILL level
                   is given above. If used, this numeric value directly
                   follows the THERMALKILL hardness level.

    EXAMPLE: THERMALKILL   127   2.0
              THK   127   2.0

16. DATA-NAME: TYPE   ABBREVIATION:

    DATA TYPE: Character String   APP. PROGRAMS: AA

    UNITS: GROUP NAME:

    MINIMUM: MAXIMUM:

    DEFAULT: COM   QUANTUM:

    DESCRIPTION: The specific-name indicates the type of site being
                   described. One of the specific-names (COM, RELAY, C2,
                   C3, AIRBASE, TERM) must be selected for the TYPE data-
                   name value.

    EXAMPLE: TYPE   RELAY
              TYPE   C2

17. DATA-NAME: VULNUMBERKILL   ABBREVIATION: VNK

    DATA TYPE: Vulnerability number   APP PROGRAMS: DAMAGE

    UNITS: GROUP NAME:

    MINIMUM: 1P0 or 1Q0   MAXIMUM: 57P9 or 57Q9

    DEFAULT: 99P0 or 99Q0   QUANTUM:

    DESCRIPTION: The value represents the vulnerability number of the
                   site. The value must be equalled or exceeded in order
                   to render the system inoperative. Input values above
                   the maximum are treated as 99P0; this value signifies
                   an invulnerable site.

    EXAMPLE: VULNUMBERKILL   2P27
              VNK   3Q4

18. DATA-NAME: XRAYKILL   ABBREVIATION: XRK

     DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

     UNITS: Cal/cm^2 GROUP NAME:

     MINIMUM: 1 X 10^{-6} MAXIMUM: 10.22

     DEFAULT: 10.23   QUANTUM: 1 X 10^{-6}

     DESCRIPTION: The value represents the threshold level which must be
                     equalled or exceeded in order to render a site inopera-
                     tive. A default value of 10.23 is used to signify a
                     site which is invulnerable to x-ray radiation effects.

     EXAMPLE: XRAYKILL 7.21
               XRK   7.21

     DATA-NAME: ABBREVIATION:

     DATA TYPE: Numeric   APP PROGRAMS:

     UNITS: GROUP NAME:

     MINIMUM: 0.0   MAXIMUM: 10.0

     DEFAULT: 0.0   QUANTUM:

     DESCRIPTION: The sigma value corresponding to the XRAYKILL level
                     given above. If used, this numeric value directly
                     follows the XRAYKILL hardness level.

     EXAMPLE: XRAYKILL 7.21 1.2
               XRK   7.21 1.2

2.2.4.4 <u>COMSYSTEMCHAR Section</u>. The COMSYSTEMCHAR section is used to define characteristics which are generally applicable to the description of particular communications systems. These characteristics can be referenced and used to expand the description of a site by providing additional data at the communications equipment level. The use of this input section is optional, but when it is used, it is introduced by:

DEFINE COMSYSTEMCHAR

where COMSYSTEMCHAR is the specific-name used to designate this section of the input data. In an input data deck which includes all sections, the COMSYSTEMCHAR section follows the SITECHAR section. When sections of data are omitted, the input data deck will not show any traces of the omitted section. This demonstrates the flexibility of the IE programs to process segments of the ETC^3 data base independently.

The data elements belonging to this section are similar to those in the SITECHAR section. In many instances, the data elements share identical data-names, however, they represent the corresponing values for the site and the communication system equipment. The majority of the data elements are used to define the vulnerability characteristics of the communication equipment being described. The remaining data elements are used to define the operational characteristics of the system. The data-names of this section are described in Table 2.9.

Each COMSYSTEMCHAR entry describes a communication system as illustrated in Figure 2.4. The communication equipment at the four sites is independent from the associated sites, thus the values to be supplied should reflect the communication system equipment and not the sites (as discussed in the preceding input data section). The data-names are identical in many cases, but are applicable to different entities.

The data element order within this section is the following:

IDENT

general communication system characteristics (CHARRATE, FRE-
    QUENCY, and/or TYPE)

EQUIPMENT NODEE1

Table 2.9.   COMSYSTEMCHAR section data-names.

DATA NAME	DATA-NAME DESCRIPTION
IDENT	Name or character string identifying a set of communication characteristics
CHARRATE	Communication character transmission rate
DPIMPULSEKILL	Threshold level for dynamic pressure impulse destruction
DPKILL	Threshold level for dynamic pressure destruction
EQUIPMENT	Identifies whether the data is for a line or a node
FREQUENCY	Communication system tramsission frequency
GAMMADOTKILL	Th eshold level for gamma radiation flux destruction
GAMMAKILL	Threshold level for gamma radiation destruction
HAEMPKILL	Threshold level for High Altitude EMP (HAEMP) destruction
LAEMPKILL	Threshold level for Low Altitude EMP (LAEMP) destruction
NEUTRONKILL	Threshold level for neutron radiation destruction
OPIMPULSEKILL	Threshold level for overpressure impulse destruction
OPKILL	Threshold level for overpressure destruction
PROBDAMAGEVNK	Probability of damage for a given vulnerability number
THERMALKILL	Threshold level for thermal radiation damage
TYPE	Identifies the type of circuit
VULNUMBERKILL	Threshold vulnerability number for the destruction
XRAYKILL	Threshold level for X-ray radiation destruction
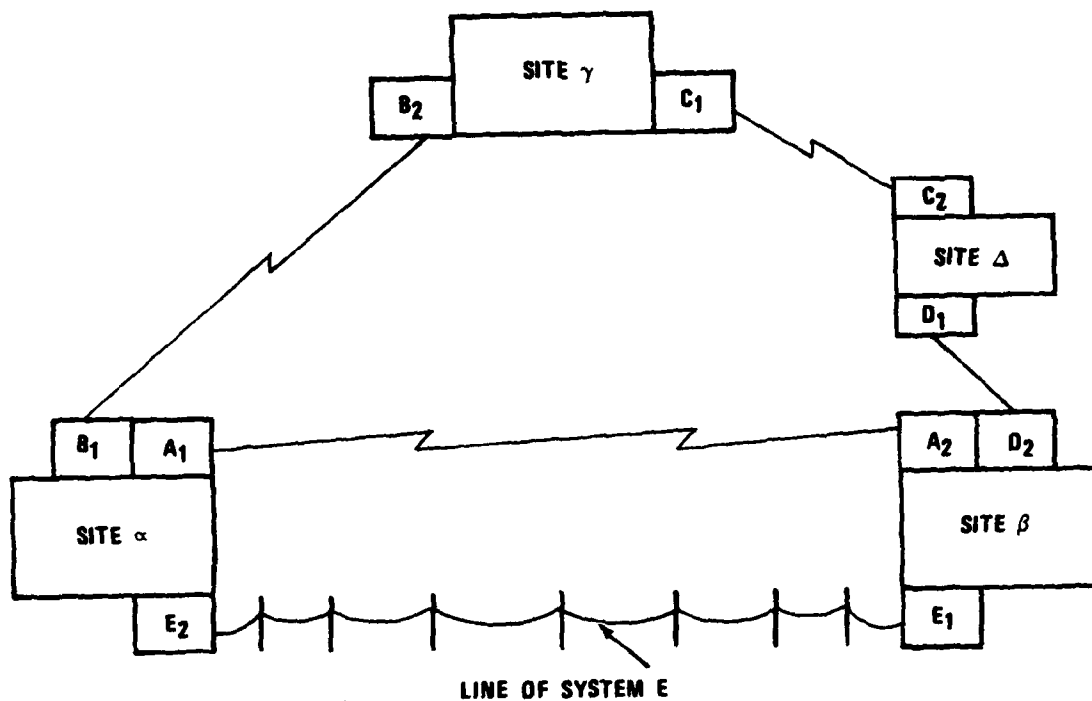
THE COMMUNICATION SYSTEMS A B C D AND E HAVE
SEPARATE CHARACTERISTICS FROM THE SITES α β γ AND Δ .

Figure 2.4. Representative communication system.

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nuclear vulnerability of node E1

EQUIPMENT NODEE2

nuclear vulnerability of node E2

EQUIPMENT LINE

nuclear vulnerability of the communication line

The nuclear effect data-names may each be used a maximum of three times. Unused data should be omitted, i.e., the data element EQUIPMENT LINE and following data would be left out if this is a radio link. The EQUIPMENT groups maybe in any order.

Sigma values may be specified for some of the data-names which are used to define various types of nuclear effects damage threshold levels. These sigma values are incorporated into the ETC^3 data base. The current DAMAGE applications program does not perform a probabilistic assessment of the nuclear damage; however, some data is available for probabilistic damage assessment.

1. DATA-NAME: IDENT   ABBREVIATION: ID

    DATA TYPE: Character string or   APP. PROGRAMS:
                user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The input is an identifier for a set of communications
                    system characteristics. It signifies a data entity for
                    this section and serves as a reference label for data
                    in other input section.

    EXAMPLE: IDENT   NICS

2. DATA-NAME: CHARRATE   ABBREVIATION: CR

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Characters/sec   GROUP NAME: Transmission rate

    MINIMUM: 0   MAXIMUM: 1677.7215

    DEFAULT: 1677.7215   QUANTUM: 0.0001

    DESCRIPTION: The value is the rate at which messages are transmitted
                    by the communication system being described. A default
                    value equal to the maximum transmission rate is used if
                    no user value is supplied.

    EXAMPLE: CHARRATE 100
              CR   100

3.   DATA-NAME: DPIMPULSEKILL   ABBREVIATION: DPIK

     DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

     UNITS: Psi-seconds   GROUP NAME:

     MINIMUM: 0.1   MAXIMUM: 6553.4

     DEFAULT: 6553.5   QUANTUM: 0.1

     DESCRIPTION: The value represents the threshold level for damage to
                    a communications system from dynamic pressure impulse
                    effects. Must follow an EQUIPMENT data element. A
                    default value indicates the equipment is invulnerable
                    to dynamic pressure impulse.

     EXAMPLE: DPIMPULSEKILL   4.2
               DPIK   4.2

     DATA-NAME: ABBREVIATION:

     DATA TYPE: Numeric   APP. PROGRAMS:

     UNITS: GROUP NAME:

     MINIMUM: 0.0   MAXIMUM: 10.0

     DEFAULT: 0.0   QUANTUM:

     DESCRIPTION: The sigma value corresponding to the DPIMPULSEKILL
                    level given above. If used, this numeric value
                    directly follows the DPIMPULSEKILL hardness level.

     EXAMPLE: DPIMPULSEKILL   4.2 2.5
               DPIK   4.2 2.5

4. DATA-NAME: DPKILL   ABBREVIATION: DPK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Psi   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 6553.4

    DEFAULT: 6553.5   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold level for dynamic
                    pressure that will render a communication system inoper-
                    ative. A default value of 6553.5 psi is used to
                    signify a dynamic pressure invulnerable communication
                    system. Must follow an EQUIPMENT data-name.

    EXAMPLE: DPKILL   ,5
              DPK   ,5

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the DPKILL level given
                    above. If used, this numeric value directly follows
                    the DPKILL hardness level.

    EXAMPLE: DPKILL   .5   1.5
              DPK   .5   1.5

5.   DATA-NAME: EQUIPMENT   ABBREVIATION:

     DATA TYPE: Specific-name   APP. PROGRAMS:

     UNITS: GROUP NAME: Specific-name

     MINIMUM: MAXIMUM:

     DEFAULT: All equipment is invul- QUANTUM:
               nerable to nuclear
               effects.

     DESCRIPTION: The specific-name (LINE, NODE1, NODE2) selected by the
                    user indicates the portion of the communication being
                    described. NODE1 and NODE2 specific-names are related
                    to the two identifiers for the CONNECT data-name in the
                    COMLINE input data section. This data element may be
                    repeated once with each specific-name.

     EXAMPLE: EQUIPMENT NODE1
               EQUIPMENT LINE

6.   DATA-NAME: FREQUENCY   ABBREVIATION: FREQ

     DATA TYPE: Numeric   APP. PROGRAMS:

     UNITS: Megahertz   GROUP NAME: Frequency

     MINIMUM: 0   MAXIMUM: 16777.215

     DEFAULT: QUANTUM: .001

     DESCRIPTION: The value represents the approximate transmitter fre-
                    quency for the communications system.

     EXAMPLE: FREQUENCY   102.3
               FREQ   102.3

7. DATA-NAME: GAMMADOTKILL   ABBREVIATION: GMDK

   DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

   UNITS: Rads/Second   GROUP NAME:

   MINIMUM: 1×10^5 MAXIMUM: 1×10^{14}

   DEFAULT: 0   QUANTUM:

   DESCRIPTION: The value represents the threshold level for sufficient
                 gamma flux rated to render the communication system
                 inoperative. The default value of 0 results in a
                 communications system which is invulnerable to gamma
                 radiation flux effects. Must follow an EQUIPMENT
                 data-name.

   EXAMPLE: GAMMADOTKILL   2E7

             MDK   5.3E10

   DATA-NAME: ABBREVIATION:

   DATA TYPE: Numeric   APP. PROGRAMS:

   UNITS: GROUP NAME:

   MINIMUM: 0.0   MAXIMUM: 10.0

   DEFAULT: 0.0   QUANTUM:

   DESCRIPTION: The sigma value corresponding to the GAMMADOTKILL level
                 given above. If used, this numeric value directly
                 follows the GAMMADOTKILL hardness level.

   EXAMPLE: GAMMADOTKILL   1E6   1.9

             GMDK   1.2E9   1.9

8. DATA-NAME: GAMMAKILL   ABBREVIATION: GMK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Rads   GROUP NAME:

    MINIMUM: 1   MAXIMUM: 65534

    DEFAULT: 65535   QUANTUM: 1

    DESCRIPTION: The value represents the threshold level of gamma
                    radiation necessary to incapacitate a communication
                    system. The default value of 65535 is used to render
                    the communication system invulnerable to gamma radia-
                    tion effects. Must follow an EQUIPMENT data-name.

    EXAMPLE: GAMMAKILL   750
              GMK   900

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the GAMMAKILL level
                    given above. If used, this numeric value directly
                    follows the GAMMAKILL hardness level.

    EXAMPLE: GAMMAKILL   750 1.2
              GMK   900 1.2

9.   DATA-NAME: HAEMPKILL   ABBREVIATION: HEK

      DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

      UNITS: Kilovolts/meter   GROUP NAME:

      MINIMUM: 0.1   MAXIMUM: 102.2

      DEFAULT: 102.3   QUANTUM: 0.1

      DESCRIPTION: The value represents the threshold level for high
                     altitude EMP effects to incapacitate a communication
                     system. A default value of 102.3 is used to signify a
                     site which is invulnerable to HAEMP effects. Must
                     follow an EQUIPMENT data-name.

      EXAMPLE: HAEMPKILL   50.4
                HEK   50.4

      DATA-NAME: ABBREVIATION:

      DATA TYPE: Numeric   APP. PROGRAMS:

      UNITS: GROUP NAME:

      MINIMUM: 0.0   MAXIMUM: 10.0

      DEFAULT: 0.0   QUANTUM:

      DESCRIPTION: The sigma value corresponding to the HAEMPKILL level
                     given above. If used, this numeric value directly
                     follows the HAEMPKILL hardness value.

      EXAMPLE: HAEMPKILL   50.4   2.5
                HEK   50.4   2.5

10. DATA-NAME: LAEMPKILL   ABBREVIATION: LEK

DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

UNITS: Kilovolts/meter   GROUP NAME:

MINIMUM: 0.1   MAXIMUM: 102.2

DEFAULT: 102.3   QUANTUM: 0.1

DESCRIPTION: The value represents the threshold level for low alti-
               tude EMP to disrupt a communication system and render
               it inoperative. A default value of 102.3 signifies the
               systems is invulnerable to LAEMP effects. Must follow
               an EQUIPMENT data-name.

EXAMPLE: LAEMPKILL   25.2
          LEK   25.2

DATA-NAME: ABBREVIATION:

DATA TYPE: Numeric   APP. PROGRAMS:

UNITS: GROUP NAME:

MINIMUM: 0.0   MAXIMUM: 10.0

DEFAULT: 0.0   QUANTUM:

DESCRIPTION: The sigma value corresponding to the LAEMPKILL level
               given above. If used, this numeric value directly
               follows the LAEMPKILL hardness level.

EXAMPLE: LAEMPKILL   25.2   3.0
          LEK   25.2   3.0

11. DATA-NAME: NEUTRONKILL   ABBREVIATION: NK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Neutrons/cm^2 GROUP NAME:

    MINIMUM: 1   MAXIMUM: 1×10^{35}

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The value is the threshold level for neutron radiation
                   to disrupt and incapacitate a communication system. A
                   default value of 0 signifies a communication system
                   which is invulnerable to neutron radiation effects.
                   Must follow an EQUIPMENT data-name.

    EXAMPLE: NEUTRONKILL   100000
              NK   1E6

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the NEUTRONKILL level
                   given above. If used, this numeric value directly
                   follows the NEUTRONKILL hardness level.

    EXAMPLE: NEUTRONKILL   100000   3.5

              NK   100000   3.5

12. DATA-NAME: OPIMPULSEKILL   ABBREVIATION: OPIK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Psi-seconds   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 6553.4

    DEFAULT: 6553.5   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold level of the over-
                  pressure impulse to disrupt and incapacitate a communi-
                  cation system. A default value indicates this equip-
                  ment is invulnerable to overpressure impulse. Must
                  follow an EQUIPMENT data-name.

    EXAMPLE: OPIMPULSEKILL   11.2
              OPIK   16.

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0   MAXIMUM: 10

    DEFAULT: 0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the OPIMPULSEKILL
                  level given above. If used, this numeric value
                  directly follows the OPIMPULSEKILL hardness level.

    EXAMPLE: OPIMPULSEKILL   16.2   1.9
              OPIK   16.2   1.9

13. DATA-NAME: OPKILL   ABBREVIATION: OPK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Psi   GROUP NAME:

    MINIMUM: 0.1   MAXIMUM: 6553.4

    DEFAULT: 6553.5   QUANTUM: 0.1

    DESCRIPTION: The value represents the threshold level of the over-
                    pressured needed to render a communication system
                    inoperative. A default value of 6553.5 signifies a
                    system which is not vulnerable to this effect. Must
                    follow an EQUIPMENT data-name.

    EXAMPLE: OPKILL   432.1
              OPK   432.1

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the OPKILL level given
                    above. If used, this numeric value directly follows
                    the OPKILL hardness level.

    EXAMPLE: OPKILL   432.1   2.2
              OPK   432.1   2.2

14. DATA-NAME: PROBDAMAGEVNK   ABBREVIATION: PDVNK

DATA TYPE: Numeric   APP. PROGRAMS:

UNITS: GROUP NAME: Probability

MINIMUM: 0.01   MAXIMUM: 1.00

DEFAULT: 0.90   QUANTUM: 0.01

DESCRIPTION: The value represents the probability of damage associated with the vulnerability number of the communication system being described. A default value of .9 is used when a value is not supplied. Must follow an EQUIPMENT data-name.

EXAMPLE: PROBDAMAGEVNK   0.5

15. DATA-NAME: THERMALKILL   ABBREVIATION: THK

     DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

     UNITS: Cal/cm^2 GROUP NAME:

     MINIMUM: 1   MAXIMUM: 254

     DEFAULT: 255   QUANTUM: 1

     DESCRIPTION: The value represents the threshold level of thermal
                     radiation needed to render a communication system
                     inoperative. A default value of 255 signifies that the
                     communications system being described is not vulnerable
                     to thermal radiation damage. Must follow an EQUIPMENT
                     data-name.

     EXAMPLE: THERMALKILL   75
               THK   75

     DATA-NAME: ABBREVIATION:

     DATA TYPE: Numeric   APP. PROGRAMS:

     UNITS: GROUP NAME:

     MINIMUM: 0.0   MAXIMUM: 10.0

     DEFAULT: 0.0   QUANTUM:

     DESCRIPTION: The sigma value corresponding to the THERMALKILL level
                     given above. If used, this numeric value directly
                     follows the THERMALKILL Hardness level.

     EXAMPLE: THERMALKILL   75   1.5
               THK   75   1.5

16. DATA-NAME: TYPE   ABBREVIATION:

    DATA TYPE: Specific-Name   APP. PROGRAMS:

    UNITS: GROUP NAME: Specific-name

    MINIMUM: MAXIMUM:

    DEFAULT: CABLE   QUANTUM:

    DESCRIPTION: The specific-name selected (CABLE, MICROWAVE, ELF, VLF,
                  LF, HF, VHF, UHF and SHF) indicates the type of circuit
                  being used for the communication system. CABLE is the
                  default type of communications circuit.

    EXAMPLE: TYPE   VLF
              TYPE   MICROWAVE

17. DATA-NAME: VULNUMBERKILL   ABBREVIATION: VNK

    DATA TYPE: Vulnerability   APP. PROGRAMS: DAMAGE
                number

    UNITS: GROUP NAME:

    MINIMUM: 1P0 or 1Q0   MAXIMUM: 57P9 or 57Q9

    DEFAULT: 99P0, 99Q0   QUANTUM:

    DESCRIPTION: The value represents the vulnerability number of the
                  communications system equipment. Input values 99P0 and
                  99Q0 are invulnerable. Must follow an EQUIPMENT data-
                  name.

    EXAMPLE: VULNUNBERKILL   3P5
              VNK   2Q3

18. DATA-NAME: XRAYKILL   ABBREVIATION: XRK

    DATA TYPE: Numeric   APP. PROGRAMS: DAMAGE

    UNITS: Cal/cm^2 GROUP NAME:

    MINIMUM: 0.01   MAXIMUM: 10.22

    DEFAULT: 10.23   QUANTUM:

    DESCRIPTION: The value represents the threshold strength of X-ray
                   radiation needed to render a communication system
                   inoperative. A default value of 10.23 signifies a
                   communication system which is not vulnerable to X-ray
                   radiation damage. Must follow an EQUIPMENT data-name.

    EXAMPLE: XRAYKILL   4.52
              XRK   4.52

    DATA-NAME: ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME:

    MINIMUM: 0.0   MAXIMUM: 10.0

    DEFAULT: 0.0   QUANTUM:

    DESCRIPTION: The sigma value corresponding to the level given above.
                   If used, this numeric value directly follows the
                   XRAYKILL hardness level.

    EXAMPLE: XRAYKILL   4.52   2.5
              XRK   4.52   2.5

2.2.4.5 MESSAGECHAR Section. The MESSAGECHAR section is used to define sets of message characteristics which describe a particular message. Two data elements currently make up a set of message characteristics. The use of the MESSAGECHAR input section is dependent on whether the SITECHAR and EVENT input sections are used. The MESSAGECHAR section may be omitted from the input data deck if the SITECHAR and EVENT sections are omitted. If either the SITECHAR or EVENT sections are included in the input deck, this section is needed. The MESSAGECHAR section is introduced by

DEFINE MESSAGECHAR

where MESSAGECHAR is the specific name designating this input data section. In a complete input deck, the MESSAGECHAR section follows the COMSYSTEMCHAR section.

The two data-names constituting the MESSAGECHAR section are described in Table 2.10.

TABLE 2.10. MESSAGECHAR section data-names

DATA NAME	DATA-NAME DESCRIPTION
IDENT	Name or character string identifying a set of message characteristics
CHARACTER	Message length in the number of characters

A sample MESSAGECHAR input data section will resemble the example to be given. In preparing the input cards, it facilitates manual review of the input data when the cards are produced according to a format.

```
DEFINE MESSAGECHAR /*SECTION HEADING*/
ID   EAMBA        CHAR   200
ID   SELREL       CHAR   1200
```

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1. DATA-NAME: IDENT   ABBREVIATION ID

    DATA TYPE: Character string,   APP. PROGRAMS:
                user-name

    UNITS: GROUP NAME

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The identifier for this type of message. This identi-
                   fier must be first, and is used by other sections to
                   reference this type of message.

    EXAMPLE: ID   EAM3A

2. DATA-NAME: CHARACTER   ABBREVIATION: CHAR

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Count   GROUP NAME:

    MINIMUM: 0   MAXIMUM: 16777215

    DEFAULT: 100   QUANTUM: 1

    DESCRIPTION: The value supplied indicates the number of characters
                   appearing in the message.

    EXAMPLE: CHAR   200

2.2.4.6 <u>PROCEDURE Section</u>. The PROCEDURE section is used to identify message processing procedures which are to be employed on particular messages. The need for this input section is dependent on data references made in the SITECHAR input section with the IDPROC data-name. This section is introduced by

DEFINE PROCEDURE

where PROCEDURE is the specific name designating this input data section. In a complete IEB input data deck, this section follows the MESSAGECHAR section of data.

The single data element in the PROCEDURE section is the data-name:

IDENT - Name or character string identifying a procedure.

Currently, there are no application programs requiring message processing procedures in the ETC^3 set of computer programs.

1. DATA-NAME: IDENT   ABBREVIATION: ID

   DATA TYPE: Character string   APP. PROGRAMS:
               or user-name

   UNITS: GROUP NAME: Identifier

   MINIMUM: MAXIMUM:

   DEFAULT: User assigned   QUANTUM:

   DESCRIPTION: The identifier supplied identifies the procedure which
                  is to be used in the processing of the message. The
                  identifier allows data in other input sections to
                  reference the associated message processing procedure.

   EXAMPLE: ID   EAMFIRST

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2.2.4.7 <u>SITE Section</u>. The SITE section is used to identify specific command, control and communications sites whose impairment in a nuclear environment would affect the C^3 network. Specific information concerning a particular site is provided to the IEB program through this input section. General site characteristics are used to augment site descriptions by referencing data in the SITECHAR input section. This input section is required if data in the EVENT or COMLINE sections reference sites which need to be identfied and defined in this section. The section is introduced by

DEFINE SITE

where SITE is the specific-name designating this section of the input data deck. In a complete input data deck, the SITE section follows the PROCEDURE section.

The data elements, which are used to define a site, are identified and defined in Table 2.11. These data elements are used principally to identify specific communication aspects of the site, and characteristics of threats against the site. Each data-name is used no more than once in identifying a site. Data values for the LOCATION and TERMINALCODE data-names are supplied in a slightly different manner.

The use of the LOCATION data-name is fully described earlier in the manual, however, a brief summary is provided here. The location may be specified in either UTM or geodetic coordinate form. Geodetic coordinates may be expressed as decimal degrees or in degrees, minutes, and seconds form. The convention for assigning signs follow those for latitude and longitude. North latitude and east longitude are positive, while south latitude and west longitude are negative. In addition, the altitude of the location either above sea level or local terrain may be specified by the data value for the LOCATION data-name. The data-name is followed by an equal sign with the data values enclosed in parentheses. Each data value, which can be a UTM location designation, latitude, longitude, or altitude, is separated from its successor by a comma. The coordinate occurs before the altitude, with latitude before longitude. When the geodetic form is used, a space is used between the degrees, minutes, and seconds when such divisions are used to specify the latitude and longitude.

Table 2.11.   SITE section data-names.

DATA NAME	DATA-NAME DESCRIPTION
IDENT	Identifier of this site
HEIGHTOFBURST	User specified height of burst for threats on the site
IDSITECHAR	Identifier of a set of site characteristics
IDWEAPON	Identifier of the type weapon to be used against the site
LEVEL	Hierarchial level of site in the command and control system
LOCATION	Geographic location and altitude of the site
TERMINALCODE	Code identifying communication information at the site

```
/*        SAMPLE  INPUT FOR SITE SECTION      */

    IDENT  BLUELEADER

       LOC = (42    15,    2)

       IDSITECHAR    HARDCENTER
```

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The data entry for the TERMINALCODE data-name is a character string which is character position dependent. Each position may be assigned one of several codes to indicate a type of terminal. This is needed because a site may be the terminal for several communication systems. This code is the same as that used by DCA in describing the DCS systems.

1. DATA-NAME: IDENT   ABBREVIATION: ID

    DATA TYPE: Character string,   APP. PROGRAMS: AA, DAMAGE
                user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The character string or data-name identifies a partic-
                    ular communication command and control site. Each site
                    is a data entity specified by the data elements of this
                    section. The example below is a character string
                    because it contains imbedded blanks.

    EXAMPLE: ID   'ADENALL GE DCS'

2. DATA-NAME: HEIGHTOFBURST   ABBREVIATION: HOB

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Meters   GROUP NAME: Altitude (9)

    MINIMUM: 0   MAXIMUM: 16777215

    DEFAULT: -2×10^{7} QUANTUM: 1

    DESCRIPTION: The value supplied for the height of burst indicates
                    the altitude at which nuclear bursts would produce
                    maximum damage effects to the communications site. The
                    default value indicates the application program should
                    calculate the optimum height of burst from the nuclear
                    vulnerability data. This data is reserved for future
                    scenario generation programs.

    EXAMPLE: HOB   1000

3. DATA-NAME: IDSITECHAR   ABBREVIATION: IDC

    DATA TYPE: Character string,   APP. PROGRAMS: AA, DAMAGE
                user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The identifier is used as a reference into the data
                   entitites contained in the SITECHAR input data section.
                   The SITECHAR data entitites provide supplemental infor-
                   mation such as nuclear vulnerability concerning a
                   particular site as identified in this section.

    EXAMPLE: IDC   VREP

4. DATA-NAME: IDWEAPON   ABBREVIATION: IDN

    DATA TYPE: Character string   APP. PROGRAMS:
                or User-name

    UNITS: GROUP NAME: User-name

    MINIMUM: MAXIMUM:

    DEFAULT: QUANTUM:

    DESCRIPTION: The identifier specifies the only weapon to be used
                   against the particular communication site identified by
                   this IDENT.

    EXAMPLE: IDN   BMI

5. DATA-NAME: LEVEL   ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS: AA

    UNITS: Unitless   GROUP NAME: Relative number (0)

    MINIMUM: 0   MAXIMUM: 255

    DEFAULT: 1   QUANTUM: 1

    DESCRIPTION: The value assigned indicates the level of the communi-
                    cations command and control site in the system
                    hierarchial structure.

    EXAMPLE: LEVEL   22

6. DATA-NAME: LOCATION   ABBREVIATION: LOC

    DATA TYPE: Numeric   APP. PROGRAMS: AA, DAMAGE

    UNITS: GROUP NAME: Location

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The LOCATION data-name is used to specify the geo-
                    graphic location of a site. The location at the
                    beginning of the simulation is used for mobile sites.
                    The method specifying location has been previously
                    described under 2.2.1.6.

    EXAMPLE: LOC = (29   26   40,   -03   15   23)

7. DATA-NAME: TERMINALCODE   ABBREVIATION: TMC

DATA TYPE: Character String   APP. PROGRAMS:

UNITS: GROUP NAME:

MINIMUM: MAXIMUM:

DEFAULT: Blanks   QUANTUM:

DESCRIPTION: The specific values are used to describe the site as a
                communication terminal. The site can have one of these
                terminal codes. This data is derived from DCS
                information.

Character Pos	Entry	Definition
1	A	VON Switch
2	D	DIN Switch
3	S	SEVOCOM Switch
4	E	ETS Switch
5	R	Repeater Switch
6	B	International Border
7	C	Cable head
8	T8	Government set. ter.
	L9	Commercial set. ter.
	M10	Military set. ter.
9	V	Satellite
10	P	Local PBX present
11	L	Lease interface present

EXAMPLE: TMC   '   T8   '

              TMC   'A   PL'
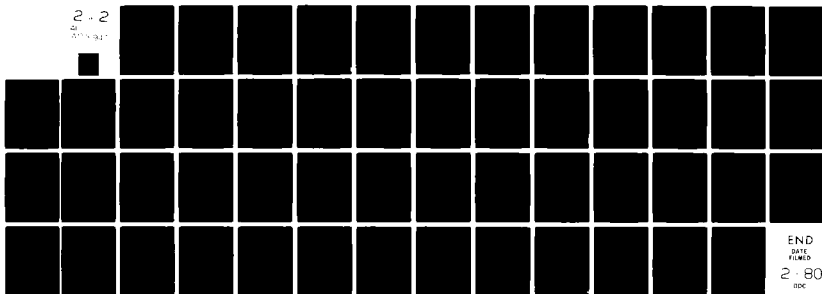
2.2.4.8 <u>COMLINE Section</u>. The COMLINE section is used to define communica-
tion lines by designating the end nodes of the line and by specifying
characteristics of the communicaton line. Additional information on the
communication aspects of the line can exist in the COMSYSTEMCHAR section;
this information is referenced to complete the description of the communi-
caton line being defined. Communication lines defined in this section may
be referenced by data in the COMNET section. The use of this section is
optional, but is not independent of all remaining input data sections.
When the section is used it is introduced by:

DEFINE COMLINE

where the DEFINE is an IE reserved data-name used to initiate a data
section, and COMLINE is specific-name designating the specific input
section. In a complete set of input sections, the COMLINE section follows
the SITE section.

The data elements of this section, which are used to define a
communication line, are listed and described in Table 2.12. Each data-name
is used no more than once for each communication line described. The
CONNECT data-name is the single data element which requires two data
values, all others require one. The two data values supplied for the
CONNECT data-name must correspond to sites identified in the SITE input
section. They are placed after the data-name and blanks are used to
separate the identifiers.

A sample COMLINE input data section is provided to illustrate the
use of the data elements in defining a set of communication lines. The
full and abbreviated forms of the data-names are used in the examples.

```
DEFINE COMLINE
IDENT     LINE A3   CAPACITY 100   IDCSC     SATELLITE     SNR 12
CONNECT   ALPHA     BETA
POB .90   TYPE  FULL
```

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Table 2.12. COMLINE section data-names.

DATA NAME	DATA-NAME DESCRIPTION
IDENT	Character string or user name identifying the communication line
CAPACITY	User specific capacity measure for the line
CONNECT	Specifies the sites to be connected by the line
IDCOMSYSCHAR	Identifier used to reference data in COMSYSTEMCHAR section
NORMOPSNRATIO	Normal operating signal-to-noise ratio of the line
PROBOPBENIGN	Probability of communication line being operational in benign environment
TYPE	The operating mode of communication line connecting the nodes.

1. DATA-NAME: IDENT   ABBREVIATION: ID

   DATA TYPE: Character string,   APP. PROGRAMS:
              or user-name

   UNITS: GROUP NAME: Identifier

   MINIMUM: MAXIMUM:

   DEFAULT: User assigned   QUANTUM:

   DESCRIPTION: The user-name or character string identifies a communi-
                   cation line. The identifier enables data in other
                   input sections to reference a specific communication
                   line when necessary.

   EXAMPLE: IDENT   LINEA3

2. DATA-NAME: CAPACITY   ABBREVIATION: CAP

   DATA TYPE: Numeric   APP. PROGRAMS:

   UNITS: GROUP NAME:

   MINIMUM: 0   MAXIMUM: 10^9

   DEFAULT: 100   QUANTUM: 1

   DESCRIPTION: The CAPACITY data-name is used by he analyst to repre-
                   sent some unique capacity measure.

   EXAMPLE: CAPACITY   1900

3. DATA-NAME: CONNECT   ABBREVIATION:

    DATA TYPE: Character string   APP. PROGRAMS:
                 or user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The CONNECT data-name requires the use of two identi-
                    fiers. These two data entries correspond to "NODE1"
                    and "NODE2" respectively of the communication line
                    being described. See data-name EQUIPMENT in Section
                    COMSYSTEMCHAR.

    EXAMPLE: CONNECT   ALPHA   BETA

4. DATA-NAME: IDCOMSYSCHAR   ABBREVIATION: IDSC

    DATA TYPE: Character string   APP. PROGRAMS:
                 or user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: Blanks   QUANTUM:

    DESCRIPTION: The user-name or character string is used as a means of
                    referencing additional data in the COMSYSTEMCHAR
                    section of the input data deck. The reference data
                    provides additional descriptive data about the
                    operating characteristics of this communications line.

    EXAMPLE: IDCOMSYSTEMCHAR   SATELLITE

5. DATA-NAME: NORMOPSNRATIO   ABBREVIATION: SNR

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Decibels   GROUP NAME:

    MINIMUM: 0   MAXIMUM: 31

    DEFAULT: 20   QUANTUM: 1

    DESCRIPTION: The value represents the normal operating signal to
                    noise ratio of the communication line described. The
                    default value provides the communication line with a
                    signal to noise ratio of 20 db.

    EXAMPLE: NORMOPSNRATIO   12
                    SNR   12

6. DATA-NAME: PROBOPBENIGN   ABBREVIATION: POB

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME: Probability

    MINIMUM: 0.000   MAXIMUM: 1.000

    DEFAULT: 1.000   QUANTUM: 0.001

    DESCRIPTION: The input value represents the operational probability
                    of the communication line in a benign environment. The
                    default value of 1.0 indicates certainty of communica-
                    tion line operation.

    EXAMPLE: PROBOPBENIGN   .90
                    POB   .90

```
7.   DATA-NAME:  TYPE                    ABBREVIATION:

     DATA TYPE:  Specific-name           APP. PROGRAMS:

     UNITS:                              GROUP NAME:  Specific-name

     MINIMUM:                            MAXIMUM:

     DEFAULT:  FULL                      QUANTUM:

     DESCRIPTION:    A specific-name (ONEWAY, HALF, FULL) is selected to
                     define the transmission capability of the communication
                     line being described.
                     1.   ONEWAY - One way communication line (NODE1 to
                          NODE2 of the CONNECT data name)
                     2.   HALF  - Two way communication line, half duplex.
                     3.   FULL  - Two way communication line, full duplex.

     EXAMPLE:        TYPE      ONEWAY
                     TYPE      FULL
```

2.2.4.9 <u>COMNET Section</u>. The COMNET section is used to define communica-
tion networks by specifying the communication lines making up the network.
The communication lines which make up each network need to be identified in
the COMLINE section. In a complete input data deck, the COMNET section
follows the COMLINE section. The use of this input section is optional,
but the section is not independent of other input sections. The EVENT
input section may reference communication networks specified in this
section. The section is introduced by

        DEFINE COMNET

where COMNET is the specific name designating this input data section.

Two data elements are used to specify a communication network and
they are:

IDENT	Character string or user-name identifying a network.
COMLINE	Lines forming a communication network.

The COMLINE data-name will accept more than a single communication line
identifier. If more tha one identifier is used, the line identifiers are
enclosed in parentheses and separated by commas. The communication line
identifiers following the COMLINE data-name identify the lines making up
the network.

A sample COMNET input data section is reproduced below to illus-
trate how the data section is used to define communication networks. In
the example below:

```
DEFINE    COMNET
IDENT     'CEMETERY NET'
COMLINE   =(UKS014, UKS016, UKS028, UKS034)
```

there is one network identified as CEMETERY NET which is composed of the
communication lines, UKS014, UKS016, UKS028, and UKS034.

1. DATA-NAME: IDENT   ABBREVIATION: ID

   DATA TYPE: Character string,   APP. PROGRAMS:
                user-name

   UNITS: GROUP NAME: Identifier

   MINIMUM: MAXIMUM:

   DEFAULT: User assigned   QUANTUM:

   DESCRIPTION: The user-name or character string is used to identify a
                  communications network. The network consists of a set
                  of the communication lines identified in the COMLINE
                  input section.

   EXAMPLE: IDENT   ACEHIGH

2. DATA-NAME: COMLINE   ABBREVIATION: LINE

   DATA TYPE: Character string   APP. PROGRAMS:
                or user-name

   UNITS: GROUP NAME:

   MINIMUM: MAXIMUM:

   DEFAULT: User assigned   QUANTUM:

   DESCRIPTION: The communication line(s) constituting a network is
                  identified by the COMLINE data-name. The names of the
                  communications lines making up a network are enclosed
                  in a set of parentheses. The communication line identi-
                  fiers are separated by commas within the parentheses.

   EXAMPLE: COMLINE   = (UKSO14,UKSO16,UKSO34)

                  COMLINE   UKSO28

2.2.4.10 <u>EVENT Section</u>. The EVENT section is used to define the occurence of C^3 events by combining input data from the MESSAGECHAR SITE, COMLINE, and COMNET sections together to set the background for the occurrence of an event. It also defines how the event is to be processed. The combination process is performed by referencing data in other sections through the data-names IDCOMLINE, IDOMNET, IDMESSAGECHAR, and IDSITExxxxx. The last data-name is completed by selecting one of four possible substitutable replacements for the x's. The omission of this data section does not impact on other input sections because references are not made to data contained in this input section. This section follows the COMNET section in a complete input data deck. When used, the section is introduced by:

DEFINE EVENT

The data elements of this section are listed and defined in Table 2.13. Each data element is used at most once to define an event, and a single data value is associated with each data-name. The four replacements for the x's are:

1. REC   - Receiving site
2. SEND   - Sending site
3. DEST   - Destination site
4. SOURCE   - Source site

A sample EVENT input data section is included to illustrate the use of the data-names in the definition of an ETC^3 event.

```
DEFINE EVENT
 IDENT ONE
  TYPE  DEBUG  TIME  10
 IDENT TWO
  TYPE MESSAGE  TIME 300
  IDSITEREC  ALPHA
  IDSITESOURCE  BETA
  IDMESSAGECHAR  SELRELLEVEL3
  IDCOMNET  HOTEL
```

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Table 2.13. EVENT section data-names.

DATA NAME	DATA-NAME DESCRIPTION
IDENT	Character string of user-name identifying the event
IDCOMLINE	Communication line affected by the event
IDCOMNET	Communication network affected by the event
IDMESSAGECHAR	Characteristics of the message affected by the event
IDSITExxxxx	Site affected by the event
TIME	Game time the event is to occur
TYPE	Type of event

1. DATA-NAME: IDENT   ABBREVIATION: ID

    DATA TYPE: Character string   APP. PROGRAMS:
               or user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: QUANTUM:

    DESCRIPTION: The user-name or character string identifies an ETC^3
                  event.

    EXAMPLE: IDENT   STARTSELREL

2. DATA-NAME: IDCOMLINE   ABBREVIATION: IDCL

    DATA TYPE: Character string   APP. PROGRAMS:
                  or user-name

    UNITS: GROUP NAME:

    MINIMUM: MAXIMUM:

    DEFAULT: QUANTUM:

    DESCRIPTION: The user-name or character string is used to reference
                  a communications line description in the COMLINE input
                  data section. The value corresponds to the user-name
                  supplied for the IDENT in the COMLINE section.

    EXAMPLE: IDCOMLINE   LINE3

3. DATA-NAME: IDCOMNET   ABBREVIATION: IDCN

DATA TYPE: Character string   APP. PROGRAMS:
or user-name

UNITS: GROUP NAME: Identifier

MINIMUM: MAXIMUM:

DEFAULT: QUANTUM:

DESCRIPTION: The user-name or character string reference a communi-
cations network specified in the COMNET input section.
The reference is accomplished by using the same user-
name for the IDENT in the COMNET input section and the
IDCOMNET in this section.

EXAMPLE: IDCOMNET   CEMETERY

4. DATA-NAME: IDMESSAGECHAR   ABBREVIATION: IDMC

DATA TYPE: Character string   APP. PROGRAMS:
or user-Name

UNITS: GROUP NAME: Identifier

MINIMUM: MAXIMUM:

DEFAULT: QUANTUM:

DESCRIPTION: The user-name or character string references a set of
message characteristics defined in the MESSAGECHAR
input section. The reference is done by using iden-
tical user-names for the IDENT data-name in the
MESSAGECHAR section and the IDMESSAGECHAR data-name in
this section.

EXAMPLE: IDMESSAGECHAR SELRELA17

5. DATA-NAME: IDSITExxxxx   ABBREVIATION: IDSxxxxx

    DATA TYPE: Character string   APP. PROGRAMS:
                or user-name

    UNITS: GROUP NAME:

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: Four data-names are presented by the IDSITExxxx designa-
                   tion. A data name is formed by replacement of the
                   xxxxx's with one of the following possibilities: 1.
                   REC - receiving site; 2. SEND - sending site; 3. DEST -
                   destination site; 4. SOURCE - source site. The user-
                   name to be used with the selected data-name references
                   an IDENT in the SITE section.

    EXAMPLE: IDSITEREC   ALPHA   IDSSOURCE   BETA

6. DATA-NAME: TIME   ABBREVIATION:

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Seconds   GROUP NAME: Game Time

    MINIMUM: 0.0   MAXIMUM: $MAXTIME

    DEFAULT: User-assigned   QUANTUM: $QNTTIME

    DESCRIPTION: The value represents the time of an event; the time is
                   given in game time seconds from the start of the
                   simulation. Events should be time sequenced for easy
                   reference. The maximum and quantum time values are
                   specified via the SST preprocessor.

    EXAMPLE: TIME   3600.75

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7.   DATA-NAME: TYPE   ABBREVIATION:

DATA TYPE: Specific-name   APP. PROGRAMS:

UNITS: GROUP NAME: Specific-name

MINIMUM: MAXIMUM:

DEFAULT: QUANTUM:

DESCRIPTION: The specific-name (DEBUG, NODEBUG, ENDGAME, ABORT, MESSAGE, and MSG) selected determine the EVENT type. The MESSAGE and MSG specific-names are considered identical by the program.

EXAMPLE: TYPE   MSG
                 TYPE   DEBUG

2.2.4.11 <u>THREATBM Section</u>. The THREATBM section is used to define ballistic missile threats which are to be included in the ETC^3 data base. The data are used to describe the launch and impact criteria for the missile threat. The description of the threats are supplemented by referencing the delivery vehicle characteristics provided in the THREATCHAR section. The THREATBM section is the last input section of the IEB data deck. If the section is used, it is introduced by:

DEFINE THREATBM

where THREATBM is the specific-name used to designate this input section.

The data elements for the THREATBM section are used principally to define the flight parameters of the missile threat. They are listed and defined in Table 2-14. All data elements in this section use the standard method of data entry. Each data-name is followed by a single data value. In specifying latitude and longitude values, north latitudes and east longitudes are positive, while south latitude and west longitudes are negative. The times for the launch and burst are related in that a time of launch will be computed when the time of burst is specified. In addition, the computed time of launch should be inspected to insure that launch time is within game time frame.

A sample THREATBM section is included below to illustrate how threat data is prepared for the IEB program.

```
DEFINE THREATBM
 IDENT  BM1   IDTHREATCHAR  SS9
  LATBURST  45  LONGBURST  -30  ALTBURST  200
 IDENT  BM2   IDTHREATCHAR  SS11A
  LATBURST  46  LONGBURST  -23  ALTBURST  103.5
 IDTARGET   'DUMMY SITE'
 TIMEBURST  4200
```

Table 2.14.   THREATBM data-names.

DATA NAME	DATA-NAME DESCRIPTION
IDENT	Character string or user-name identifying the threat cell
ALTBURST	Burst altitude for the missiles
ALTLAUNCH	Launch altitude for the missiles
ANGLELAUNCH	Launch angle for the missiles
IDLAUNCH	Character string or user-name identifying the threat cell
IDTARGET	Character string or user-name identifying the target of the threat cell
IDTHREATCHAR	Identifier used to reference a set of threat characteristics
LATBURST	Burst latitude for the missiles
LATLAUNCH	Launch latitude for the missiles
LONGBURST	Burst longitude for the missiles
LONGLAUNCH	Launch longitude for the missiles
NUMOBJECTS	Number of missiles
TIMEBURST	Time of burst for the missiles
TIMELAUNCH	Time of launch for the missiles
VELOCITY	Velocity of the missile

1. DATA-NAME: IDENT   ABBREVIATION: ID

    DATA TYPE: Character string or   APP. PROGRAMS:
    user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: BMnnnn   QUANTUM:

    DESCRIPTION: The data entry identifies the ballistic missile threat
    to be described. If not supplied by the user, default
    threat identifications are supplied by the IEB program
    by incrementing the nnnn portion of the identifier.
    This is the only identifier that is generated by IEB if
    one is not supplied by the user.

    EXAMPLE: IDENT   WAVE5BM36

2. DATA-NAME: ALTBURST   ABBREVIATION: H2

    DATA TYPE: Numeric   APP. PROGRAMS: AA, DAMAGE

    UNITS: Meters   GROUP NAME: Altitude

    MINIMUM: 0   MAXIMUM: 100000

    DEFAULT: 0   QUANTUM: 1

    DESCRIPTION: The value represents the altitude of the burst above
    desired ground zero for the missile threat. This
    height of burst is currently being used in the ETC^3
    model. Default value results in ground level bursts.

    EXAMPLE: ALBURST 1000

3.　DATA-NAME: ALTLAUNCH　　　　　ABBREVIATION:　H1

　　DATA TYPE:　Numeric　　　　　APP. PROGRAMS:　AA

　　UNITS:　Meters　　　　　　　　GROUP NAME:　Altitude

　　MINIMUM:　0　　　　　　　　　MAXIMUM:　32767

　　DEFAULT:　0　　　　　　　　　QUANTUM:

　　DESCRIPTION:　The value represents the altitude of the launch point
　　　　　　　　　above sea level.　Default value for the launch altitude
　　　　　　　　　is sea level.

　　EXAMPLE:　　　ALTLAUNCH　　　0

4.　DATA-NAME:　ANGLELAUNCH　　　ABBREVIATION:　AL

　　DATA TYPE:　　Numeric　　　　APP. PROGRAMS:

　　UNITS:　Degrees　　　　　　　GROUP NAME:　Angle

　　MINIMUM:　0　　　　　　　　　MAXIMUM:　89.9

　　DEFAULT:　90　　　　　　　　QUANTUM:　0.0057

　　DESCRIPTION:　The value represents the launch angle of the missile
　　　　　　　　　threat.　The angle is specified in degrees up to a
　　　　　　　　　maximum of 89.9°.　The default value indicates a threat
　　　　　　　　　missile launch which uses a minimum energy trajectory.

　　EXAMPLE:　　　ANGLELAUNCH　　　23.7

5. DATA-NAME: IDLAUNCH   ABBREVIATION: IDLNCH

   DATA TYPE: Character string or   APP. PROGRAMS: AA
              user-name

   UNITS: GROUP NAME: Identifier

   MINIMUM: MAXIMUM:

   DEFAULT: Blanks   QUANTUM:

   DESCRIPTION: The user-name or character string identifies the launch
                  point for the missile threat being defined. It aids
                  the user in recognizing threats, but is not used for
                  data referencing.

   EXAMPLE: IDLAUNCH   BASEAX

6. DATA-NAME: IDTARGET   ABBREVIATION: IDTGT

   DATA TYPE: Character string   APP. PROGRAMS:
                 or user-name

   UNITS: GROUP NAME: Identifier

   MINIMUM: MAXIMUM:

   DEFAULT: QUANTUM:

   DESCRIPTION: The user-name or character string identifies the target
                  for the missile threat being defined. It aids the user
                  in recognizing threats, but is not used for data
                  referencing.

   EXAMPLE: IDTARGET COLDBLOW

7. DATA-NAME: IDTHREATCHAR   ABBREVIATION: IDC

    DATA TYPE: Character string   APP. PROGRAMS: AA, DAMAGE
                or user-name

    UNITS: GROUP NAME: Identifier

    MINIMUM: MAXIMUM:

    DEFAULT: User assigned   QUANTUM:

    DESCRIPTION: The user-name or character string identifies a set of
                   threat characteristics in the THREATCHAR input section
                   which describes the threat vehicle characteristics.
                   The user name for IDTHREATCHAR should match the user-
                   name supplied for an IDENT data-name in the THREATCHAR
                   section.

    EXAMPLE: IDTHREATCHAR   SS11
                   IDC   SS9

8. DATA-NAME: LATBURST   ABBREVIATION: F2

    DATA TYPE: Numeric   APP. PROGRAMS: AA, DAMAGE

    UNITS: Degrees   GROUP NAME: Latitude

    MINIMUM: -89   MAXIMUM: 89

    DEFAULT: 415   QUANTUM: .00057

    DESCRIPTION: The numeric value is the latitude of the desired ground
                   zero of the missile threat being defined. South
                   latitude designations are prefixed by a negative sign,
                   while north latitude designations may or may not be
                   prefixed by a positive sign.

    EXAMPLE: LATBURST 45   15   7

9. DATA-NAME: LATLAUNCH   ABBREVIATION: F1

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Degrees   GROUP NAME: Latitude

    MINIMUM: -89   MAXIMUM: 89

    DEFAULT: 60   QUANTUM: .00057

    DESCRIPTION: The numeric value is the launch latitude of the missile
                   cell being described. A negative sign is used with
                   south latitudes, while a positive sign may be used with
                   north latitudes. The default value is 60° north
                   latitude.

    EXAMPLE: LATLAUNCH   30   30   10

10. DATA-NAME: LONGBURST   ABBREVIATION: G2

    DATA TYPE: Numeric   APP. PROGRAMS: AA

    UNITS: Degrees   GROUP NAME: Longitude

    MINIMUM: -180   MAXIMUM: 180

    DEFAULT: 87.5   QUANTUM: 0.00057

    DESCRIPTION: The numeric value is the longitude of the desired
                   ground zero for the missile cell being described. A
                   negative sign is used with west longitude values, while
                   an optional positive sign is used with east longitude.
                   The default value is 87.5 degrees east longitude.

    EXAMPLE: LONGBURST   87   30

11. DATA-NAME: LONGLAUNCH   ABBREVIATION: G1

    DATA TYPE: Numeric   APP. PROGRAMS: AA, DAMAGE

    UNITS: Degrees   GROUP NAME: Longitude

    MINIMUM: -180   MAXIMUM: 180

    DEFAULT: -80   QUANTUM: .00057

    DESCRIPTION: The numeric value is the launch longitude of the missile being described. Use of a positive sign for east longitudes is optional, while use of negative sign for west longitudes is required.

    EXAMPLE: LONGLAUNCH   -80   25 10

12. DATA-NAME: NUMOBJECTS   ABBREVIATION: NOC

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: GROUP NAME: Count

    MINIMUM: 0   MAXIMUM: 7

    DEFAULT: 1   QUANTUM: 1

    DESCRIPTION: The numeric value is the number of missiles in the cell being defined. Each cell may consist of up to seven missiles, the default is one missile per cell.

    EXAMPLE: NOC   3

13. DATA-NAME: TIMEBURST   ABBREVIATION: T2

  DATA TYPE: Numeric   APP. PROGRAMS: AA

  UNITS: Seconds   GROUP NAME: Game Time

  MINIMUM: 0   MAXIMUM: 268435.46

  DEFAULT: QUANTUM: 0.01

  DESCRIPTION: The numeric value is the time of burst for the missile threat being defined. It should not be specified when the launch time value is also specified for the same threat vehicle. When a time of burst is supplied, the launch time is computed.

  EXAMPLE: TIMEBURST 7200

14. DATA-NAME: TIMELAUNCH   ABBREVIATION: T1

  DATA TYPE: Numeric   APP. PROGRAMS: AA

  UNITS: Seconds   GROUP NAME: Game Time

  MINIMUM: 0   MAXIMUM: 268435.46

  DEFAULT: 0   QUANTUM: 0.01

  DESCRIPTION: The numeric value is the launch time for the missile threat being defined. It is the time from the start of the simulation. If the TIMEBURST data-name is used, the time of launch is computed and this entry should be omitted.

  EXAMPLE: TIMELAUNCH 3600

15. DATA-NAME: VELOCITY   ABBREVIATION: V

    DATA TYPE: Numeric   APP. PROGRAMS:

    UNITS: Meters/second   GROUP NAME: Velocity

    MINIMUM: 0.1   MAXIMUM: 6553.5

    DEFAULT: 1000   QUANTUM: 0.1

    DESCRIPTION: The numeric value supplied by the user is replaced by
                   calculated values. This input can be used by future
                   scenario generated programs.

    EXAMPLE: VELOCITY   1200

2.2.5 Associated Data Names.

Program IEB was developed to process the input data in sections; to provide the user flexibility in generating the data base. However, there are relationships between input data from different sections which need to be considered in the production of acceptable input data for the IEC program. Requirements of the IEC program and the design of the data transference between the IEB and IEC programs forces the user to consider these relationships in preparing the IEB input data. Failure to account for these data dependencies will result in repeated executions of the IEB program.

The preceding section, IEB Input Preparation Section 2.2.2, identified the data-names whose usage results in references to data in other sections. This section will identify and summarize the data cross references which can occur in the preparation of the IEB input data. Data element cross references are summarized in Table 2.15. Table 2.15 lists the data-names appearing in each input data section and identifies data-names which can result in cross references.

Data-name associations are summarized in Table 2-16. The data-name appears in the first column, the section in which the data-name belongs appears in the second column. The third column indicates the associated data-names and the fourth column identifies the input sections of the associated data-names.

Table 2.15. IEB input data-names.

IEB INPUT SECTIONS

CONTROL	THREATCHAR	SITECHAR	COMSYSTEMCHAR	MESSAGECHAR	PROCEDURE	SITE	COMLINE	COMMNET	EVENT	THREATCOM
TITLE	IDENT	IDENT	IDENT	IDENT	IDENT	IDENT	IDENT	IDENT	IDENT	IDENT
CLASS	TYPE	TYPE	TYPE	CHARACTER		LOCATION	TYPE	COMLINE	TYPE	VELOCITY
TERRAIN	YIELD	OPKILL	OPKILL			TERMINALCODE	NORMOPSNRATIO		TIME	ANGLELAUNCH
	CEP	DPKILL	DPKILL			IDSITECHAR	ROADVEHICLE		IDCOMLINE	IDMOBJECT
	PROBVEHICLE	THERMALKILL	THERMALKILL			IDWEPON	CAPACITY		IDCOMNET	IDTHREATCHAR
		GAMMAKILL	GAMMAKILL			HEIGHT OF BURST	CONNECT		IDMESSAGECHAR	IDLAUNCH
		GAMMADOTKILL	GAMMADOTKILL				IDCOMSYSCHAR			IDTARGET
		NEUTRONKILL	NEUTRONKILL							TIMELAUNCH
		MAEMPKILL	MAEMPKILL							TIMEBURST
		LAEMPKILL	LAEMPKILL							LATBURST
		XRAYKILL	XRAYKILL							LONGBURST
		RADIATIONKILL	OPIMPULSEKILL							ALTBURST
		OPIMPULSEKILL	DPIMPULSEKILL							LATLAUNCH
		DPIMPULSEKILL	VULNUMBERKILL							LONGLAUNCH
		VULNUMBERKILL	PROBDAMAGEVNK							ALTLAUNCH
		PROBDAMAGEVNK	FREQUENCY							
		ACOUSTICKILL	CHARRATE							
		IDMESSAGECHAR	EQUIPMENT							
		IDPROCEDURE								

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Table 2.16. Associated data-names.

DATA NAME	SECTION HEADING	ASSOCIATED DATA NAMES	SECTION HEADING
TERRAIN	CONTROL	LOCATION	SITE
IDENT	MESSAGECHAR	IDMESSAGECHAR IDMESSAGECHAR	SITECHAR EVENT
IDENT	THREATCHAR	IDTHREATCHAR	THREATBM
IDENT	SITECHAR	IDSITECHAR	SITE
IDENT	COMSYSTEMCHAR	IDCOMSYSCHAR	COMLINE
IDENT	PROCEDURE	IDPROCEDURE	SITECHAR
IDENT	SITE	CONNECT IDSITE	COMLINE EVENT
IDENT	COMLINE	COMLINE IDCOMLINE	COMNET EVENT
IDENT	COMNET	IDCOMNET	EVENT

2.2.6 IEB Program Execution

Phase B of the INPUT EDITOR is coded in the FORTRAN computer language as are the Phase C and Phase P portions of the INPUT EDITOR. The developed code is executable on equipment operating under the Control Data Corporation NOS/BE 1.2 Operating System. The equipment available to BDM to execute the IE set of programs consists of the 6600 and 7600 located at the Air Force Weapons Laboratory (AFWL). The user instructions are based on the local accounting procedures for outside user access, local modifications to the operating system, and the availability of each program in loadable and executable form.

The control cards which are needed to execute the IEB program are reproduced in Figure 2.5. The accounting information and the names of the permanent files may not correspond with those of the user, in which case, the user information will be substituted. In Figure 2.5, the IEB input data deck is first copied to the temporary disk file TAPE5. The structure of the input data deck is described in Figure 2.2. TAPE 11 contains the IE specifications. The format of this file is described in the ETC^3 programmer's manual (Reference 2).

```
WBDMPDINKS,P60.
ACCOUNT,----
COPYCR,INPUT,TAPE5.
REWIND,TAPE5.
ATTACH,IEB,INEDB,ID=WDNAxxxx,MR=1.
ATTACH,TAPE11,INCAIESPEC,ID=WDNAxxxx,MR=1.
ATTACH,LIB,DEVLIB,ID=WDNAxxxx,MR=1.
REQUEST,TAPE7,*PF
LIBRARY,LIB.
RFL,120000.
IEB.
CATALOG,TAPE7,IECINPUT,ID=WDNAxxxx.
REWIND,TAPE2.
COPYCR,TAPE2,OUTPUT.
RETURN,TAPE9,TAPE2.
(EOR)
DATA DECK
(EOF)
```

Figure 2.5.   IEB program control cards.

The IEB program modules are loaded from the IEB and LIB permanent files for IEB execution. These files were created previously to support Phase B program execution. The results from program IEB is a disk file which can be catalogued. This output, identified as TAPE7, is used as the input data to the Phase C INPUT EDITOR program. Diagnostic output from IEB program execution is saved on TAPE2 and is printed after the IEB program results are printed.

The IEB program produces a listing of the input data deck in card image form. This printed list allows the user to to examine his input data for simple errors such as misspellings and other types of mistakes.

2.3 INPUT EDITOR -- Phase C (IEC)

The IEC program is executed after the Phase B program is executed. It is needed to produce a data base which the application programs can use. The IEC program does the cross checking and tabulating functions which are required to be done on the input data sections in order to produce a coordinated and consolidated data base. Input data to the IEC program are the data information records produced by the IEB program. The characteristics of the IEC computer code are identical to those described in the preceding section.

The control cards which are needed to execute the IEC computer code are identified in Figure 2.6. Again, the specific permanent file names and the accounting information may differ from those of the user. However, the names used in the figure will permit the results from the IEB execution described earlier to be used as input. The IEC program requires an input and an output file which are identified as TAPE7 and TAPE9, respectively. The data base for the application programs is stored as a sequential permanent file. Errors arising in the execution of the IEC program are contained on TAPE2, which is copied to OUTPUT.

2.4 INPUT EDITOR -- Phase P (IEP)

Phase P of the INPUT EDITOR can be executed using the results from either the IEB or IEC program as the input data source. IEP is used to produce formatted listings of the data base contents for user review and reference. The program may be used at any time in the data base generation process. It does not alter the input data base in any manner.

```
WBDMPDINKS,P60.
ACCOUNT ---
ATTACH,TAPE7,IECINPUT,ID=WDNAxxxx,MR=1.
ATTACH,IEC,INEDC,ID=WDNAxxxx,MR=1.
REQUEST,TAPE9,*PF
IEC.
CATALOG,TAPE9,IEC9INCATEST1,ID=WDNAxxx.
REWIND,TAPE2.
COPYCR,TAPE2,OUTPUT.
(EOF)
```

Figure 2.6.   IEC computer control cards.

The control cards which are needed to execute the IEP Program are shown in Figure 2.7. As in the case of the IEB and IEC programs, the control cards are specifically for the DCD 6600 and 7600 equipment located at AFWL. Phase P of the INPUT EDITOR is executed in nearly the same manner as the IEC program.

```
WBDMPDINKS,P60.
ACCOUNT----
ATTACH,TAPE9,INCATEST1,ID=WDNAxxx,MR=1.
ATTACH,TAPE11,INCAIESPEC,ID=WDNAxxx,MR=1.
ATTACH,IEP,INEDP,ID=WDNAxxx,MR=1.
IEP.
REWIND,TAPE2
COPY,TAPE2,OUTPUT.
(EOF)
```

Figure 2.7.   IEP program control cards.

CHAPTER III
DAMAGE PROGRAM

3.0   INTRODUCTION

The effects of nuclear weapon detonations on communication pro-
cesses, sites, and systems are calculated by the DAMAGE computer program
and compared with vulnerability thresholds to determine their survivabil-
ity. Its is an applications program which uses the IE structured data base
as the primary input data source. The nuclear effects and measures of
vulnerability which are computed by the program subroutines are:

(1)   dynamic pressure (DPKILL),

(2)   gamma flux (GAMMADOTKILL),

(3)   gamma (GAMMAKILL),

(4)   high altitude EMP (HAEMPKILL),

(5)   low altitude EMP (LAEMPKILL),

(6)   neutron (NEUTRONKILL),

(7)   overpressure (OPKILL),

(8)   thermal (THERMALKILL),

(9)   X-ray (XRAYKILL), and

(10)   vulnerability number (VULNUMBERKILL).

The acronyms in parentheses correspond to vulnerability thresholds speci-
fied as input to the IEB program. Each site, communication system, and
line is evaluated with respect to these measures of vulnerability.

The program calculates the damage caused to a set of targets from
a set of nuclear weapon bursts. Each target is assigned a vulnerability
threshold for each effect which can result in damaging the target. For
each nuclear detonation, the effect level at the target is calculated and
compared with the target damage threshold. If the burst results in an
effect level exceeding the threshold, the target is damaged and the details
are printed. Nuclear effects calculation may be bypassed if the target is
indicated to be hard to the particular effect; this is accomplished via
input data to the IEB program. Figure 3.1 shows the basic structure of the

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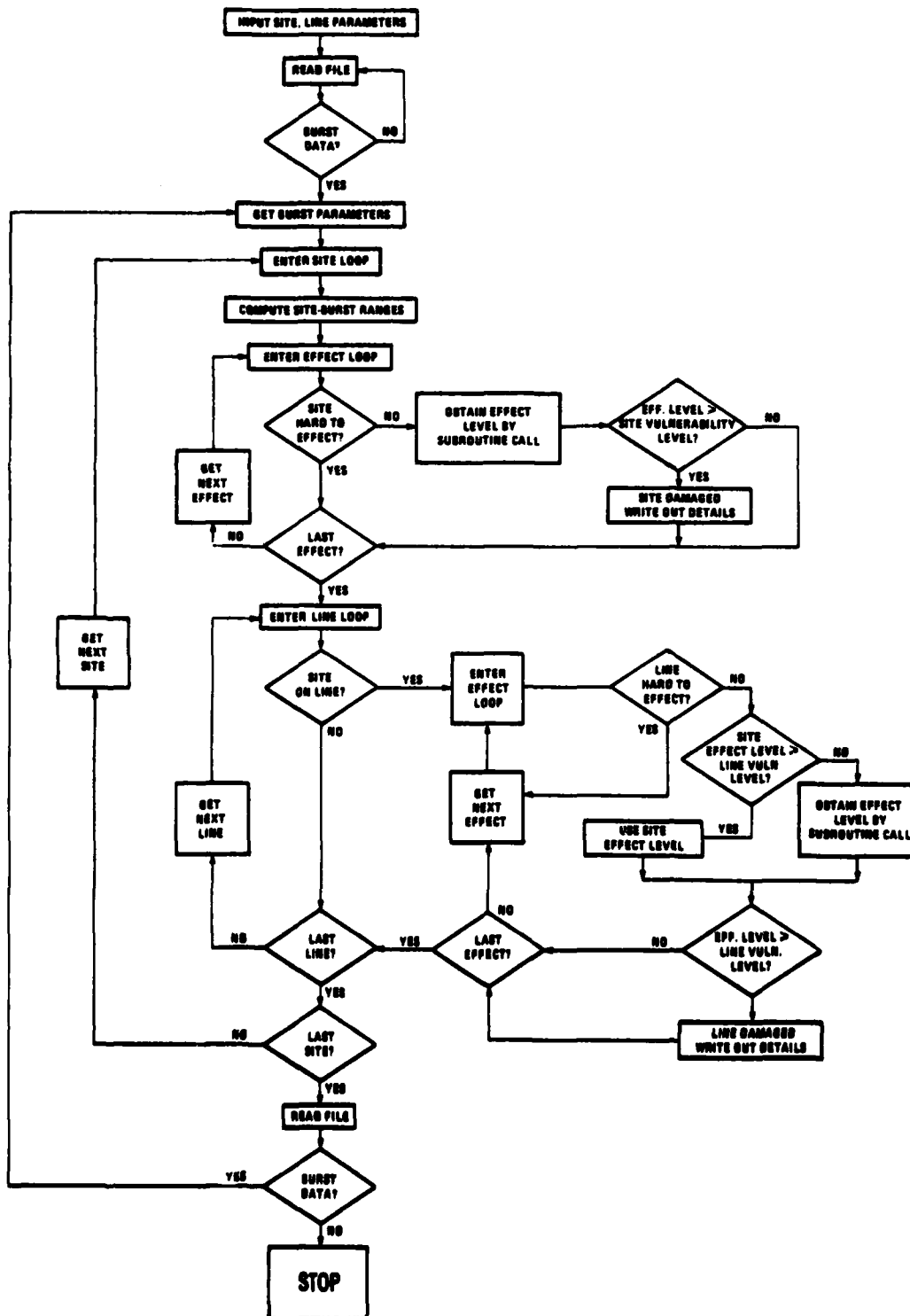
Figure 3.1.   DAMAGE program basic processing structure.

DAMAGE program. Reference 4 provides a more detailed description of the DAMAGE program than is presented in this chapter. A summary of the calculations performed for each nuclear effect is included here as a means of describing the effect and showing the method of solution. Following the description is a brief section on the actual use of the program to compute damage to targets.

3.1   Nuclear Weapon Effects

Ten measures of nuclear vulnerability can be calculated by the DAMAGE program. These measures, all of which result from nuclear detonations, are identified by the IE data names used to input the vulnerability threshold data values. This is done because the data names are descriptive of the nuclear effect calculated and associate the IE input data with the physical effects described. Each nuclear effect and the calculated vulnerability measure is described by identifying the physical parameters, the equations used and their source, and the conditions under which the calculation of the nuclear effect is performed.

3.1.1   DPKILL

DPKILL is the data name used in the IE section of the ETC^3 which is associated with dynamic pressure damage to C^3 sites and communication systems. The calculated dynamic pressure, which is expressed in units of psi, is compared with the DPKILL data values for assessing the survivability of sites and systems from dynamic pressure effects of nuclear bursts.

The DAMAGE program computes the dynamic pressure based on the peak overpressure at the point of interest. Dynamic pressure computations are not performed when the data values, which are specified in the COMSYSTEMCHAR and ISTECHAR sections of the IE input data through the DPKILL data name, use the default value. A DPKILL value in the range of 0.1 to 6534.4 psi will result in the DAMAGE program computation of dynamic pressure.

The overpressure is determined from interpolation of data from Reference 5. The computation of the overpressure is described in Section 3.1.8. The dynamic pressure computation follows from the overpressure calculation using the Rankine-Hugoniot development in Chapter 11, page 2-39 of Reference 5.

3.1.2 GAMMADOTKILL

GAMMADOTKILL is the data-name in the IE section of the ETC^3 which is associated with gamma dose rate damage to C^3 sites and communications systems. *The DAMAGE program computed dose rate is compared to the damage* threshold value to assess the survivability of the C^3 sites and systems to gamma dose rate values.

The DAMAGE program computes and prints the gamma dose rate. The computations are not performed when the data values, which are in the COMSYSTEMCHAR and SITECHAR sections of the IE input deck, are assigned default values. The use of a default value indicates that the site or system is invulnerable to the particular nuclear weapons effect. Input values for the GAMMADOTKILL data-name in the range of 10^5 and 10^{14} rads/second will cause the DAMAGE program to compute the gamma dose rate.

The equation used is obtained from the HDL Environments Report (Reference 6) and is reliable for yields between .5 and 500 kilotons and for a total dose rate between 10^7 and 10^{10} rads/second. The equation may be used with yields up to 1 megaton. The computations are reliable for low altitude bursts of up to 6 kilofeet in altitude and is based on a relative air density of .9. *The equation used is classified.*

3.1.3 GAMMAKILL

GAMMAKILL is the data-name in the IE section of the ETC^3 which is associated with *gamma radiation* damage to C^3 sites and communication systems. The DAMAGE-computed gamma radiation level is compared to the threshold damage value to assess the survivability of the C^3 sites and communication systems to gamma radiation.

The DAMAGE program computes and prints the gamma radiation level. The gamma radiation computations are not performed when the data values, which appear in the COMSYSTEMCHAR and SITECHAR sections of the IE input, are assigned default values. The use of a default value indicates complete invulnerability to the nuclear effect. Input values for GAMMAKILL in the range of 1 to 65534 will result in the computation of the gamma radiation level by the DAMAGE program.

The equation used to compute the gamma radiation, γ, is:

$$\gamma = (5.46 \times 10^3) \; W \; \left[(R^2 - .0036W^{2/3})^{1/2} \right]^{-2.89} e^{\left(-3.19 \left(R^2 - .0036W^{2/3} \right)^{1/2} \right)}$$

where the γ radiation is expressed in rads, and r is the slant range from the nuclear burst to the point of interest. The equation is obtained from the HDL Environments Report (Reference 6) and can be applied to nuclear weapons with yields ranging from .5 to 500 kilotons.

3.1.4   HAEMPKILL

HAEMPKILL is the data name in the IE section of the ETC^3 which is associated with high altitude EMP damage to C^3 sites and communication systems. The computed high altitude EMP LEVEL is compared with the damage threshold value entered into the IE data base to assess the survivability of the sites and systems to high altitude EMP effects.

The DAMAGE program computes the high altitude EMP levels from a nuclear burst for a point of interest. The EMP computations are not performed when the data values, which are defined in the COMSYSTEMCHAR and SITECHAR sections of the IEB input data deck through the HAEMPKILL dataname, are assigned the default value. The use of a default value indicates the C^3 site or communication system to be invulnerable to high altitude EMP effects. A HAEMPKILL data value in range of 0.1 to 102.2 kilovolts/meter for either section will result in the computation of high altitude EMP levels for the sites or systems.

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The magnetic field strength in magnetic north coordinates is computed by:

X = AX' where X and X' are vectors in the magnetic and true north coordinate systems and A is a 3 x 3 rotation matrix.

The magnetic field magnitude and components are:

$$BMAX = SQRT \ (1 + 3 \ Sin^2 \ (lat))$$
$$B1 = 3 \ Sin \ (lat) \ Cos \ (lat) \ Sin \ (long)$$
$$B2 = 3 \ Sin \ (lat) \ Cos \ (lat) \ Cos \ (long)$$
$$B3 = 3 \ Sin^2 \ (lat) - 1$$

The EMP level, E, is computed by:

$$E = 50 \left(\frac{h_B - 25}{R_S} \right)^2 \frac{B_p}{B_B} \ sin(\theta) \ sec \ (\phi)$$

where R_s is the slant range in kilometers and B_p and B_B are the magnetic fields at the point of interest and the burst, respectively. The secant function is a weighting factor for increased Compton current at large slant ranges. ϕ is the angle between the radius vector to the burst and the slant range vector and θ is the angle between the slant range vector and the magnetic field. The geometric relationships are illustrated in Figure 3.2.

The equation is based on a $1/r^2$ attenuation with a maximum EMP level E, of 50 kilovolts/meter. The equation is usable for heights of burst above 25 kilometers.

3.1.5   LAEMPKILL

LAEMPKILL is the data-name in the IE section of the ETC[3] which is associated with low altitude EMP damage to C^3 sites and communication systems. The DAMAGE-computed low altitude EMP level is compared to the threshold damage value to assess the survivability of the C^3 sites and systems to low altitude EMP effects.

The DAMAGE program computes and prints the low altitude EMP level. The computations are not performed when the data values, which are
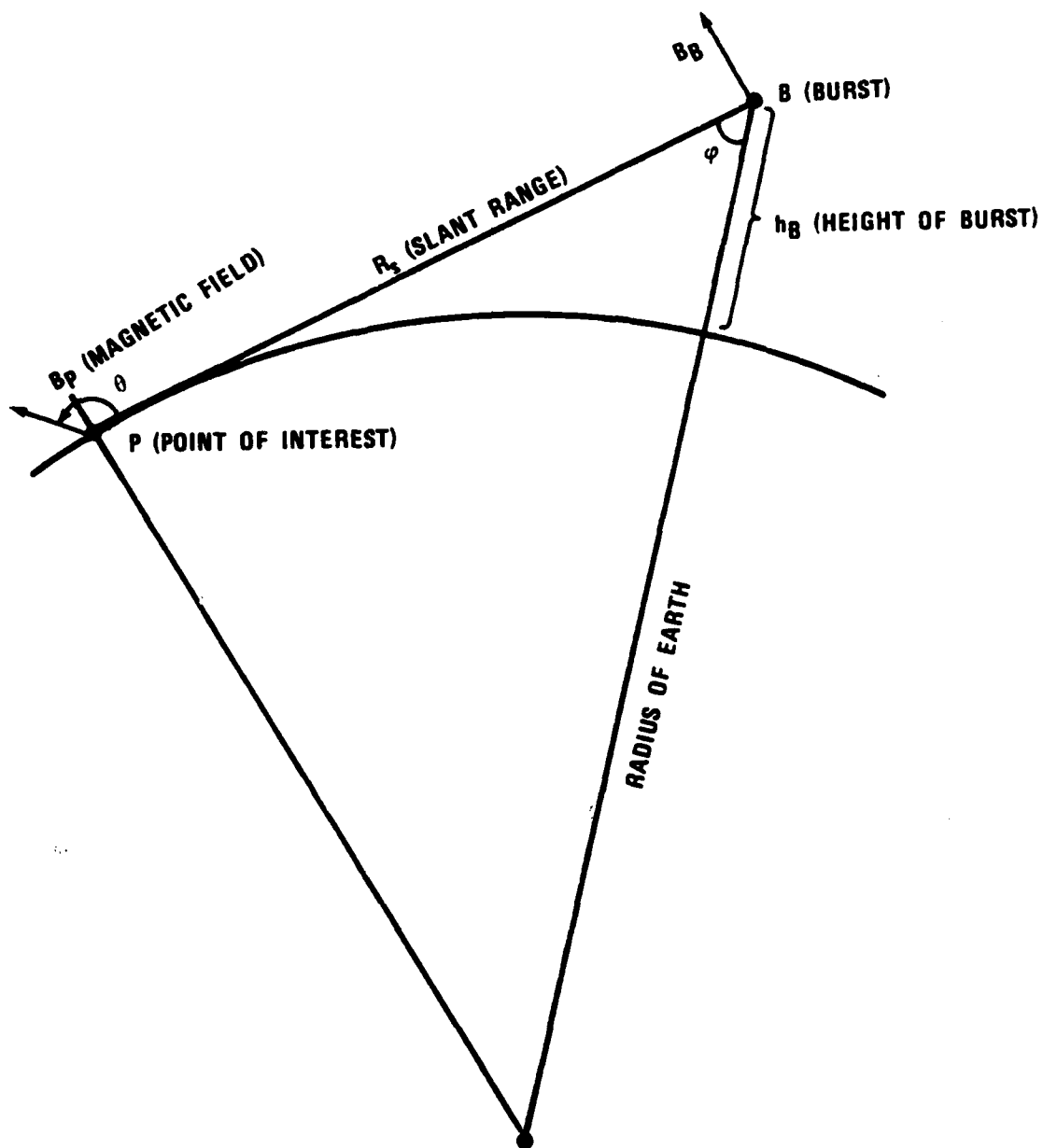
Figure 3.2. High altitude EMP geometry.

in the COMSYSTEMCHAR and SITECHAR sections of the IE input data, are default values. The use of default values indicates invulnerability to this nuclear effect. Input values for the LAEMPKILL data-name in the range of 0.1 to 102.2 kV/m will result in the DAMAGE program computing of low altitude EMP level.

The DAMAGE program computes the following components of low altitude EMP effects:

(1) E_θ -- for a surface burst over land,

(2) E_θ -- for a surface burst over water,

(3) B_θ -- for a surface burst over land, and

(4) E_r -- for a surface burst over land.

where E_θ, E_r are the peak components of the vertical and radial electric fields and B_θ is the peak azimuthal magnetic field. The electric field intensities E, are expressed in kV/m and the magnetic field component B, in gauss. The equations for computing these fields are determined by HDL from data in the LEMP-1 library (Reference 7). The equations are found on page 65 of the *HDL Environments Report (Reference 6). The equations are omitted* from this report for classification purposes (Reference 4).

3.1.6 NEUTRONKILL

NEUTRONKILL is the data-name used in the IE section of the ETC^3 which is associated with neutron flux damage to C^3 sites and communication systems. The calculated neutron flux strength is compared with the NEUTRONKILL data values for assessing the survivability of C^3 sites and communication systems.

The DAMAGE program prints the neutron flux at a point of interest removed from the nuclear burst. Neutron flux computations are not performed when the data values, which are specified in the COMSYSTEMCHAR and SITECHAR sections of the IE input data through the NEUTRONKILL data name, use the default values. A NEUTRONKILL value in the range of 1 to 10^{35} will result in the computation of neutron flux for communication systems and C^3 sites.

The neutron flux, F_n, is computed by:

$$F_n = \frac{(4.82 \times 10^{12})\ W\ e^{-4.44(R_s^2 - .0036W^{2/3})^{1/2}}}{R_s^2 - .0036W^{2/3}}$$

where R_s is the slant range in kilometers and the neutron flux is expressed in units of neutrons/cm^2. The above equation is from HDL based on a least squares fit to data generated by the ATR code (Reference 6). The calculated flux is reliable for standard fission yields of between .5 and 500 kilotons.

3.1.7   OPKILL

OPKILL is the data-name in the IE section of the ETC^3 which is associated with overpressure damage to C^3 sites and communication systems. The computed overpressure level is compared with the damage threshold value entered into the IE data base which is used to assess the survivability of sites and systems to overpressure from nuclear bursts.

The DAMAGE program computes and prints the overpressure value from a nuclear burst to a point of interest. The computed value is a function of range, yield, and height of burst and is expressed in units of psi. The overpressure computation is not performed when the data values, which appear in the COMSYSTEMCHAR and the SITECHAR sections of the input, are the default value. Data values in the range of 0.1 to 6553.4 psi will result in DAMAGE program computation of the overpressure level.

The overpressure value is computed by performing linear and logarithmic interpolation from tables of data. The data are taken from Figures 2-18, 2-19, and 2-20 of Reference 5. These are graphs of overpressure contours as a function of height of burst and ground range for a 1-kiloton nuclear burst. A cube root of the yield scaling is used for range and burst parameters.

3.1.8   THERMALKILL

THERMALKILL is the data-name in the IE section of the ETC[3] which is associated with thermal radiation damage to C^3 sites and communications systems. The computed thermal radiation level is compared to the threshold damage value entered into the IE data base to assess the survivability of the sites and communication systems to thermal radiation.

The DAMAGE program computes and prints the thermal energy from a nuclear blast at a point of interest. The energy is expressed in units of cal/cm^2. The thermal energy computations are not performed when the data values, which appear in the COMSYSTEMCHAR and SITECHAR sections of the input, are the default value. Data values falling in the range between 1.0 and 255.0 cal/cm^2 will result in the computation of the thermal energy level.

The thermal radiation computation is applicable to bursts below 10,000 feet in altitude from nuclear weapons with yields between 1 and 1000 kilotons. A visual range of 16 miles is used to indicate a clear day and sites are surface sites.

The maximum radius of the fireball, R_f, is computed by:

$$R_f = 0.18W^{0.4}.$$

The radius of the fireball R_f is expressed in kilofeet, the yield W in kilotons; this equation is from Chapter 3 of Reference 5. The thermal characteristics of weapons with burst altitudes greater than the fireball radius are not affected by the surface.

Two equations are used to compute the thermal fraction of the weapons. The use of these equations is dependent upon the altitude of the burst of the weapon. The first equation is used for heights of burst between R_f and 29.5 kilofeet, while the second is used for heights of burst up to R_f.

$$F = .38W^{.03} e^{-.007h_B}$$

$$F' = 0.21 + \frac{(F - 0.21)h_B}{R_f}$$

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where h_B is the height of burst in kilofeet and R_f is the radius of the fireball . The thermal fraction equation for F is obtained from Reference 5 and the equation for F' is based upon information derived from Reference 5.

Two equations are used to compute the thermal transmittance of the atmosphere. The first equation is used for heights of burst between 1,320 and 10,000 feet, while the second is used with heights of burst less than or equal to 1320 feet.

$$T = e^{-\left(\dfrac{[0.1075 \log_{10}(1000h_B) - 0.305] R_m}{305h_B}\right)}$$

$$T' = (1+0.001188R_m)e^{-\dfrac{0.001813R_m}{16}}$$

where R_m is the slant range in meters. These two transmittance equations are obtained from Chapter 3 of Reference 5.

The two equations to compute the thermal fraction of a nuclear burst and the two equations to compute the atmospheric transmittance may be combined in four ways to compute the thermal radiation level Q, based on height of burst considerations. The four equations and their conditions of applicability are summarized in Table 3.1.

3.1.9   VULNUMBERKILL

VULNUMBERKILL is the data name used in the IE section of the ETC[3] which is associated with the use of vulnerability numbers to assess damage. *The vulnerability number is converted to either dynamic pressure or over-* pressure values for comparison with the computed pressure to determine the survivability of a C^3 site or communication system with the associated vulnerability number.

The DAMAGE program computes and prints either the dynamic pressure or overpressure, as previously described in this chapter, and compares with the pressure equivalent of the vulnerability number. The

Table 3.1. Thermal energy equations

THERMAL ENERGY EQUATIONS	CONDITIONS OF APPLICATION
$Q = \dfrac{7.96 \times 10^6 \, WF'T'}{R_m^2}$	$Q \leq H_B < 0.18W^{.4}$ and $H_B > 1.32$kft
$Q = \dfrac{7.96 \times 10^6 \, WFT}{R_m^2}$	$0.18.4 \leq H_B \leq$ kft and $H_B > 1.32$kft
$Q = \dfrac{7.96 \times 10^6 \, WF'T}{R_m^2}$	$H_B < 0.18W.4$ and $1.32 < H_B < 10$kft
$Q = \dfrac{7.96 \times 10^6 \, WFT'}{R_m^2}$	$0.18W.4 < H_B < 1.32$kft

Note: H_B is height of burst in kilofeet

computations are not performed when the data values, which are defined in the COMSYSTEMCHAR and SITECHAR sections of the IEB input data deck, are assigned the default value. The use of the default value indicates that the site or system is invulnerable to dynamic pressure or overpressure. A VULNUMBERKILL data value in the range of 1X0 to 57X9, where the X can be P or Q, will result in the computation of the site or system survivability according to the vulnerability damage threshold. The vulnerability number appears in the form

$$V_n = n_1 X n_2$$

where n_1 indicates a potential 2-digit number, X is P or Q, and n_2 indicates a 1-digit number.

The value for the VULNUMBERKILL data-name is converted to an equivalent overpressure by the equations below if the letter P is used.

$$R = \left(\frac{n_2}{20}\right)\left(\frac{20}{W}\right)^{1/3} + \left(\left(\frac{n_2}{20}\right)\left(\frac{20}{W}\right)^{2/3} + 1 - \frac{n_2}{10}\right)^{1/2}$$

$$P_o = 10^{\left(\frac{0.21584 + (n_1 + 10.968 \log_{10} R)}{12.628}\right)}$$

where P_o is the overpressure equivalent of the vulnerability number and R is a constant used to simplify the equation.

Conversion of the vulnerability number to dynamic pressure is dependent upon the nuclear weapon yield W and the constant, W', which is computed according to the following equation:

$$W' = \frac{8n_2{}^3}{27(10-n_2)^2}$$

Two additional constants are introduced to simplify the equation for vulnerability number conversion to dynamic pressure, and they are:

$$A = -\left(\frac{n_2}{10.0}\right) \times \left(\frac{20.0}{W}\right)^{1/3}$$

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$$B = \frac{n_2}{10.0} - 1.0$$

If the yield of the nuclear weapon is less than W', the constant R is computed according to the equation:

$$R = 2.0 \left(\frac{-A}{3.0}\right)^{1/2} \cos \theta$$

where the angle θ is computed by the equation:

$$\theta = \frac{1}{3} \cos^{-1}\left(\frac{9B\sqrt{-A^3/3}}{2A^3}\right)$$

If θ is greater than $\pi/3$, θ is reduced by $2\pi/3$.

If the yield is greater than W', the constant R is computed according to the equation:

$$R = \left(\frac{-B}{2} + \left(\frac{B}{4}^2 + \frac{A^3}{27}\right)^{1/2}\right)^{1/3} + \left(\frac{-B}{2} - \left(\frac{B}{4} + \frac{A^3}{27}\right)^{1/2}\right)^{1/3}$$

where A and B are computed as shown above.

The equivalent dynamic overpressure is given by

$$P_o = 10^{\left(\frac{n_1 + 8.226 \log_{10}(R)}{5.35511}\right)}$$

where R is computed according to one of the expressions previously described.

3.1.10 XRAYKILL

XRAYKILL is the data-name in the IE section of the ETC^3 which is associated with X-ray radiation damage to C^3 sites and systems from nuclear bursts. The computed radiation level is compared to the threshold damage value entered into the IE data base to assess the survivability of the C^3 systems to X-ray radiation.

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The DAMAGE program computes and prints the X-ray radiation level.
The X-ray computations are not performed when the data values, which appear
in the COMSYSTEMCHAR and SITECHAR input sections through the XRAYKILL data-
name, use the default value. Input values for the XRAYKILL data-name
falling in the range 0.01 and 10.23 will result in the computation of the
X-ray radiation levels.

The X-ray fluence computation is idealized by having 100 percent
X-ray yield from a nuclear burst and atmospheric absorption is 100 percent.
The atmosphere is idealized to extend to an altitude of 80 kilometers and
any absorption below this altitude is total. Thus the X-ray fluence cal-
culation is meaningful only if the burst and target are above 80 km. The
X-ray fluence is computed by:

$$X = \frac{7.96\ W}{R_s^2}$$

where R_s is the slant range in kilometers. The slant range is the line-of-
site distance between burst and points of interest. For X-ray fluence to
be computed, the line-of-sight between the burst and the point of interest
must not be interrupted by the atmosphere.

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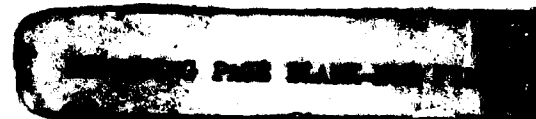   ATTN: TT-E-SS

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    ATTN: AFRDQSM

Electronic Systems Division
Department of the Air Force
    ATTN: XRC

Foreign Technology Division
Air Force Systems Command
    ATTN: NIIS Library

Headquarters Space Division
Air Force Systems Command
    ATTN: SKA

Headquarters Space Division
Air Force Systems Command
    ATTN: YCPC

Strategic Air Command
Department of the Air Force
    ATTN: XPFS
    ATTN: DCXT
    ATTN: NRT

Tactical Air Command
    ATTN: DRA

U.S. Air Forces in Europe
    ATTN: XPXX
    ATTN: DOC

OTHER GOVERNMENT AGENCY

Central Intelligence Agency
    ATTN: OSI/LSD, R. Hart
    ATTN: OSR/SEC

DEPARTMENT OF DEFENSE CONTRACTORS

BDM Corp.
    ATTN: Corporate Library
    ATTN: W. Sweeney
    ATTN: P. Bogue
    ATTN: J. Sanders

66th MI Group
    ATTN: RDA

Computer Sciences Corp.
    ATTN: H. Blank
    ATTN: Library

ESL, Inc.
    ATTN: Library
    ATTN: J. Marshall

General Electric Company—TEMPO
    ATTN: DASIAC

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    ATTN: DASIAC

GTE Sylvania, Inc.
    ATTN: M. Cross

Institute for Defense Analyses
    ATTN: D. Signori
    ATTN: Classified Library

Kaman Sciences Corp.
    ATTN: W. Long

R&D Associates
    ATTN: R. Schaefer
    ATTN: R. Latter
    ATTN: R. Poll
    ATTN: Technical Information Center
    ATTN: C. MacDonald

R&D Associates
    ATTN: L. DeLaney
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RCA Corp.
    ATTN: E. Van Keuren

SRI International
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    ATTN: C. Shoens

TRW Defense & Space Systems Group
    ATTN: R. Webb

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